AIR COMMAND HEADQUARTERS

OPERATIONAL RESEARCH DIVISION

REPORT 95/2

OPTIMUM MANNING – COMMUNICATIONS & ELECTRONICS

BY

P.E. Desmier

AIR COMMAND

OPERATIONAL RESEARCH DIVISION

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OPTIMUM MANNING – COMMUNICATIONS & ELECTRONICS

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P.E. Desmier

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ABSTRACT

The principal aim of this study was to determine the optimum number of regular force Communications & Electronics (C&E) personnel required to effectively support all deployments and taskings including Operational Plans (Oplans), annual training and exercises. The methodology used to determine the optimum number of C&E personnel is based on stochastic modelling of real life taskings. The establishment strength effective 11 Apr 95 was used as the baseline number of C&E personnel.

The results of this study provide sufficient justification for addressing the effective use of C&E personnel. It is clear that some efficiencies could be achieved in several ways. In particular, as pointed out in the conclusions of this report, there exists an immediate concern regarding the ability of Radio Operators (MOC 211) to support deployed operations due to personnel shortages if even one Oplan is activated.

RÉSUMÉ

Cette étude visait principalement à déterminer, au sein de la Force régulière, le nombre optimal d'effectifs en Communications et électronique nécessaire au maintien efficace de toutes les opérations de déploiement et de toutes les allocations de tâches, y compris celles associées aux plans opérationels, à l'entraînement annuel et aux exercices militaires. La méthodologie utilisée afin de déterminer ce nombre optimal se base sur le principe de modélisation stochastique d'allocations de tâches et de plans de contingence réels. les effectifs en date du 11 avril 1995 a servi de données de référence à l'égard du personnel en Communication et électronique.

Les résultats de cette étude nous permettent de justifier adéquatement l'emploi plus efficace du personnel en Communications et électronique. Sans doute existe-il plusieurs moyens pour apporter des améliorations. En particulier, comme on l'a souligné dans la conclusion de l'étude, la capacité des Radio (GPM 211) à soutenir les opérations de déploiement cause des inquiétudes certaines en raison de la pénurie de personnel qui existe, même dans le cas où un seul plan opérationnel est amorcé.

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EXECUTIVE SUMMARY

1. Air Command Communications and Electronics (C&E) personnel are comprised of the military occupation codes (MOCs) 221 (Radio Tech), 224 (Communications Tech), 231 (Radar Tech) and 42C (Communications and Electronics Engineer (CELE)). C&E occupations that are non Air Command are MOCs 052 (Linemen), 211 (Radio Operator), 212 (Teletype Operator), 222 (Terminal Equipment Tech) and 223 (Teletype Tech).

2. With the mandate for the Air Force to deploy on contingency operations on short notice, the principal aim of this study was to determine the optimum number of regular force C&E personnel required to effectively support all deployments and taskings including Operational Plans (Oplans), annual training and exercises. This study, therefore, determines whether optimum manning levels are consistent with the existing establishment for the C&E occupations for non-commissioned members (NCMs) and officers. The establishment strength effective 11 Apr 95 was used as the baseline number of C&E personnel (Tables 1a and 1b of main report). The establishment number of NCMs is 561. The establishment number of officers is 76.

3. A stochastic simulation was developed to model the deployment and return of C&E personnel based on real life taskings plus contingency plans. The simulation was run over a four year period with personnel removed from Wings at random intervals or specific times of each year depending on the type of deployment, training schedule or exercise. The first and last year represent the phase-in and phase-out periods for the model. The remaining two years represent the steady state approximation of the model from which the optimum manning is calculated. Output from the model consists of the number of C&E personnel on Air Command bases that are *fully deployable*. This does not include personnel who have recently returned from a deployment and are considered to be "at rest" nor does it include personnel that are available for deployments in Canada only.

4. In certain cases (particularly the non-Air Command occupations), the number of C&E personnel required to support deployed air operations will not be met by the establishment structure. In these situations, a deficiency will exist for the particular MOC and rank; and the reported number of deployable personnel may be negative. If this occurs, the establishment must be increased in order to, first of all, overcome this deficiency before addressing any optimum level of personnel.

5. Results are given in terms of the number of personnel that are fully deployable at any point in time based on the activation of 0, 1, 2 or 3 Oplans simultaneously. Cyclical trends are evident in each graph and

are largely due to training commitments where personnel are required to attend training courses and return within a 12 month period. Large dips in the curves are due to the Oplans being activated within the first 52 weeks with personnel deploying for the number of rotations specified in Table 4 of the main report.

No Oplans Activated

6. Figure Ex-1 shows the total number of C&E NCMs and officers available for deployments in a four year period based on deployments (no Oplans), taskings, training and exercises. For each graph, an upper/lower bound in the number of available personnel was taken as the mean value of the data for the ± 1 standard deviation curves in the period 1–3 years inclusive. This approximates a steady state flow of personnel. Best and worst case estimates were, therefore, evaluated at these mean values of the upper and lower bounds in the statistical spread respectively.

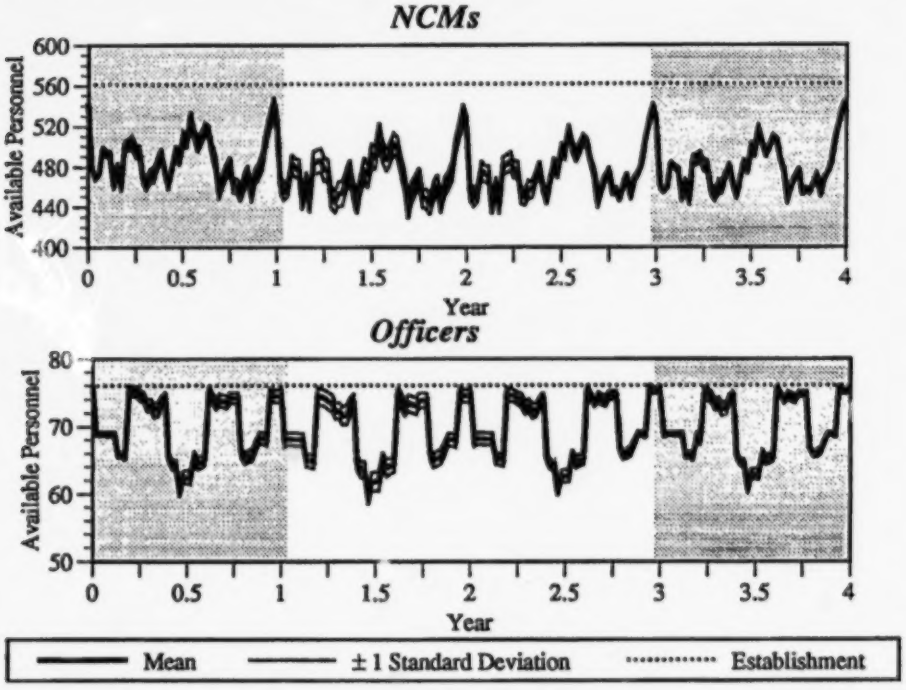

Figure Ex-1. Total personnel available for deployments: No Oplans Activated (Unshaded region of graph represents steady state)

7. For NCMs, the mean values for the ± 1 standard deviation curves in the period 1–3 years are calculated to be 464 – 485 NCMs, or 83% – 86% of the establishment value that are fully deployable. The difference is between 76 and 97 NCMs that are not deployable outside Canada. For officers, the mean values for the ± 1 standard deviation curves are calculated to be 68 – 71 officers, or 89% – 93% of the establishment value that are fully deployable. The difference is between 5 and 8 officers that are not deployable outside Canada.

1 Oplan Activated

8. Figure Ex-2 shows the total number of C&E NCMs and officers available for deployments in a four year period based on deployments, taskings, training, exercises and 1 Oplan being activated.

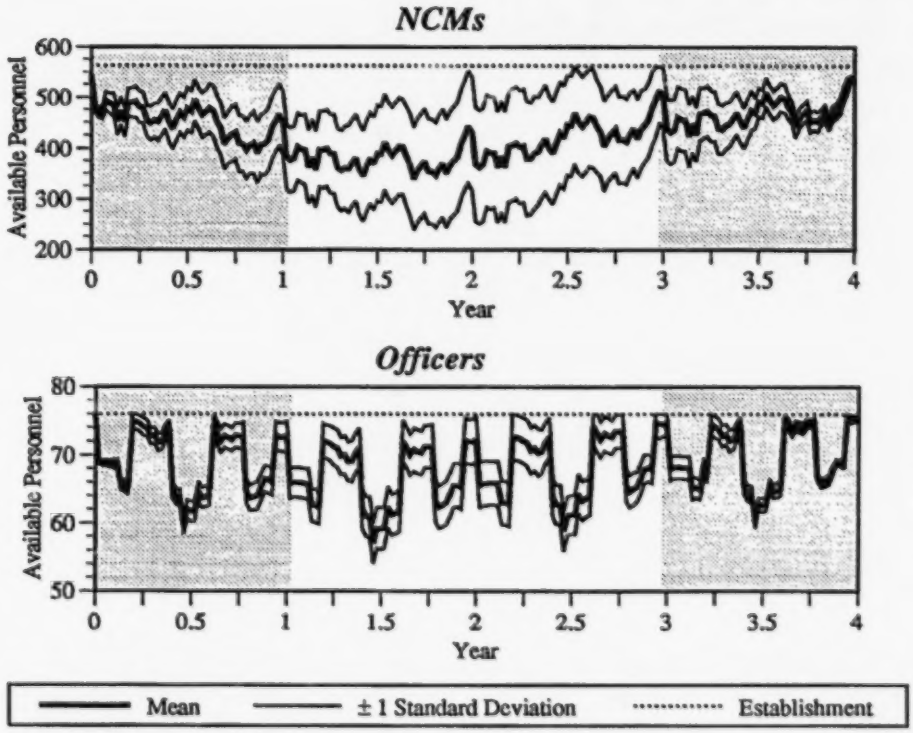

Figure Ex-2. Total personnel available for deployments: 1 Oplan Activated (Unshaded region of graph represents steady state)

9. The activation of 1 Oplan within the first 52 weeks of the four year period produces the large dips in the NCM curves. The best case (upper bound) could be interpreted as the activation of an Oplan that produces little impact on the deployment of C&E personnel, i.e., SABRE. On the other hand, the worst case (lower bound) can be interpreted as the activation of an Oplan that requires large numbers C&E personnel , i.e., SPECTRE. All other Oplans fall between these two extremes.

10. For NCMs, the mean values for the ± 1 standard deviation curves in the period 1–3 years are calculated to be 292 – 492 NCMs, or 52% – 88% of the establishment value that are fully deployable. The difference is between 69 and 269 NCMs that are not deployable outside Canada. For officers, the mean values for the ± 1 standard deviation curves are calculated to be 65 – 71 officers, or 86% – 93% of the establishment value that are fully deployable. The difference is between 5 and 11 officers that are not deployable outside Canada.

2 Oplans Activated

11. Figure Ex-3 shows the total number of C&E NCMs and officers available for deployments in a four year period based on deployments, taskings, training, exercises and a maximum of 2 Oplans activated simultaneously.

12. For NCMs, the mean values for the ± 1 standard deviation curves in the period 1–3 years are calculated to be 198 – 460 NCMs, or 35% – 82% of the establishment value that are fully deployable. The difference is between 101 and 363 NCMs that are not deployable outside Canada. For officers, the mean values for the ± 1 standard deviation curves are calculated to be 62 – 70 officers, or 82% – 92% of the establishment value that are fully deployable. The difference is between 6 and 14 officers that are not deployable outside Canada.

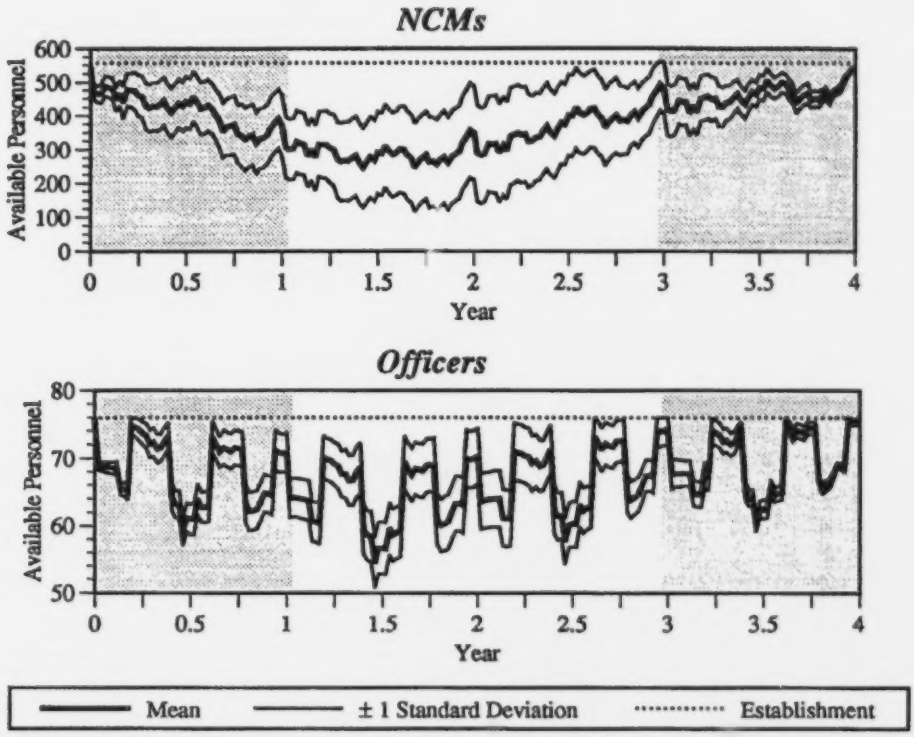

Figure Ex-3. Total personnel available for deployments: 2 Oplans Activated (Unshaded region of graph represents steady state)

3 Oplans Activated

13. Figure Ex-4 shows the total number of C&E NCMs and officers available for deployments in a four year period based on deployments, taskings, training, exercises and a maximum of 3 Oplans activated simultaneously.

14. For NCMs, the mean values for the ± 1 standard deviation curves in the period 1–3 years are calculated to be 110 – 415 NCMs, or 20% – 74% of the establishment value that are fully deployable. The difference is between 146 and 451 NCMs that are not deployable outside Canada. For officers, the mean values for the ± 1 standard deviation curves are calculated to be 61 – 69 officers, or 80% – 91% of the establishment value that are fully deployable. The difference is between 7 and 15 officers that are not deployable outside Canada.

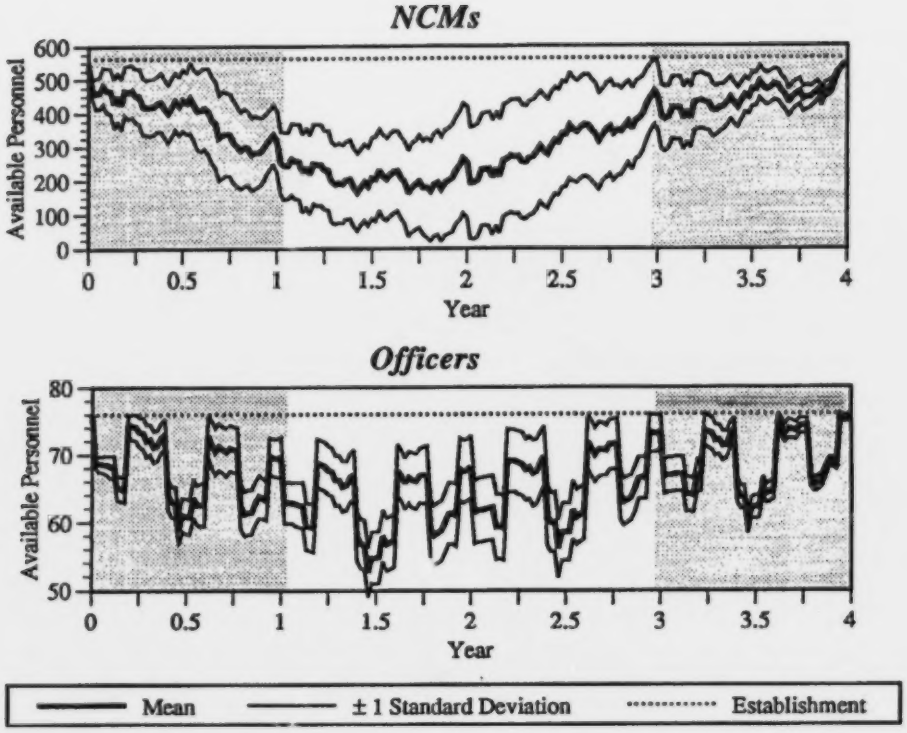

Figure Ex-4. Total personnel available for deployments: 3 Oplans Activated (Unshaded region of graph represents steady state)

Correcting Deficiencies within Non-Air Command MOCs

15. What is not shown in Figures Ex-1 – Ex-4 are the deficiencies within specific MOCs if even 1 Oplan is activated. Because we are dealing with such small establishment values for MOCs 052, 212 and 222, as Table Ex-1 shows, the use of more than two individuals will immediately drop the lower bound in the percent of establishment to a large negative value. Between SPECTRE, ORCA and CONVEYOR (non-surge) a total of 23 Linemen (052), 111 Rad Op (211), 6 Tel Op (212) and 2 TE Tech (222) personnel are utilized although establishment data specifies that only 2 Linemen, 23 Rad Op, 1 Tel Op and 2 TE Tech personnel are available.

MOC	PERCENT OF ESTABLISHMENT (%)			
	0 OPLANS	1 OPLAN	2 OPLANS	3 OPLANS
221 (Rad Tech)	81, 85	61, 87	50, 82	41, 77
224 (Comm Tech)	82, 88	76, 85	74, 85	71, 85
231 (Rdr Tech)	84, 86	67, 88	56, 83	45, 76
052 (Linemen)	100, 100	-800, 100	-1300, 100	-1600, -50
211 (Rad Op)	83, 91	-143, 91	-265, 61	-383, 4
212 (Tel Op)	100, 100	-300, 100	-300, 100	-500, 100
222 (TE Tech)	100, 100	-50, 100	-100, 100	-150, 100
223 (Tel Tech)	100, 100	0, 100	0, 100	0, 100
Total NCMs	83, 86	52, 88	35, 82	20, 74
42C	89, 93	86, 93	82, 92	80, 91
Total Officers	89, 93	86, 93	82, 92	80, 91

Table Ex-1. Lower and upper bounds to the percent of the current C&E Establishment for the number of personnel that are fully deployable

16. Regardless of the number of Oplans that are activated, the number of personnel in Non-Air Command occupations (MOCs 052, 211, 212, 222 and 223) must be accounted for in order to make the Oplans a realistic undertaking. With probabilities as high a 61% for activating one Oplan, the Non-Air Command occupations, as the current establishment stands, would have an immediate shortage of at most 53 personnel (Table 7 main report). If three Oplans were activated, the shortage increases to 128 personnel with MOC 211 (Rad Op) presenting the greatest shortage (-88 or -383% of establishment).

17. One way to alleviate these shortages within the Non-Air Command occupations (and in particular MOC 211) would be the re-skilling of the non-operator occupations. For example, Figure Ex-5 compares, for the upper curve, the summation of the lower bounds for MOCs 221, 224, 231, 052, 222 and 223 (technician occupations) with the lower bound for MOC 211 (operator occupation) for three Oplans activated simultaneously. The mean values for the upper and lower curves over the period 1–3 years are +204 and -87 respectively. Therefore, shortages for MOC 211 personnel can be more than made up through re-skilling of the technician occupations.

MOC	PERCENT OF ESTABLISHMENT (%)			
	0 OPLANS	1 OPLAN	2 OPLANS	3 OPLANS
221 (Rad Tech)	81, 85	61, 87	50, 82	41, 77
224 (Comm Tech)	82, 88	76, 85	74, 85	71, 85
231 (Rdr Tech)	84, 86	67, 88	56, 83	45, 76
052 (Linemen)	100, 100	-800, 100	-1300, 100	-1600, -50
211 (Rad Op)	83, 91	-143, 91	-265, 61	-383, 4
212 (Tel Op)	100, 100	-300, 100	-300, 100	-500, 100
222 (TE Tech)	100, 100	-50, 100	-100, 100	-150, 100
223 (Tel Tech)	100, 100	0, 100	0, 100	0, 100
Total NCMs	83, 86	52, 88	35, 82	20, 74
42C	89, 93	86, 93	82, 92	80, 91
Total Officers	89, 93	86, 93	82, 92	80, 91

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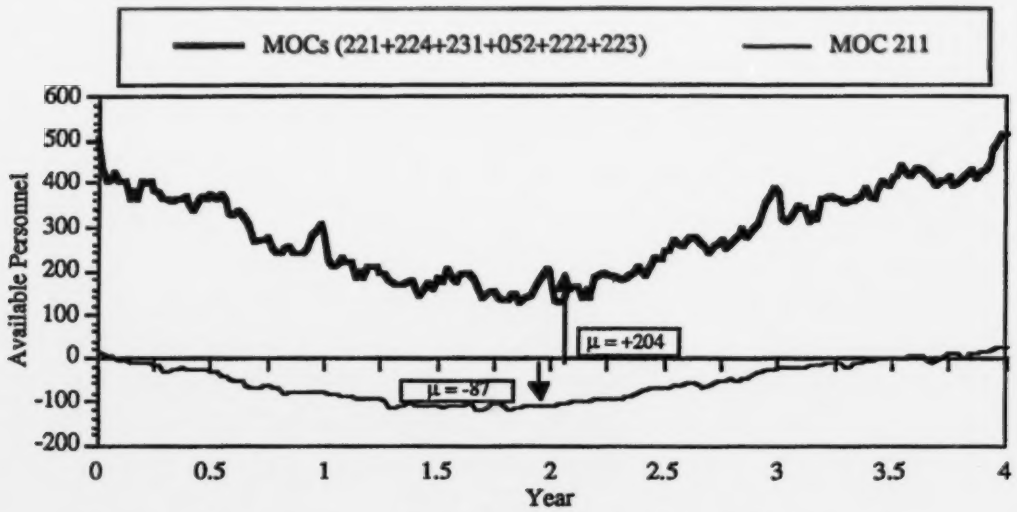

Figure Ex-5. Comparison of lower bounds for the six technical occupations (MOCs 221, 224, 231, 052, 222 and 223) and MOC 211 (3 Oplans Activated)

Recommendations

18. The results of this study provide sufficient justification for addressing the issue of Communications & Electronics personnel still being able to maintain effective support to deployments, taskings, training and Air Command Wings. It is clear that some efficiencies could be achieved in several ways. In particular, as pointed out in the conclusions of this report, there exists an immediate concern regarding the ability of Radio Operators (MOC 211) to support deployed operations due to personnel shortages if even one Oplan is activated. It is therefore recommended that:

a. A working group of interested parties be formed with a clear mandate to explore the skill sets required to provide the necessary Telecommunications and Information Services (TIS) support to deployed air operations, and make recommendations on adjustments to procedures and training; and

b. DCOS TIS be tasked to review options to redress the situation and present findings to the executive level.

OPTIMUM MANNING – COMMUNICATIONS & ELECTRONICS

1 - INTRODUCTION

1. Air Command Communications and Electronics (C&E) personnel are comprised of the military occupation codes (MOCs) 221 (Radio Tech), 224 (Communications Tech), 231 (Radar Tech) and 42C (Communications and Electronics Engineer (CELE)). C&E occupations that are non Air Command are MOCs 052 (Linemen), 211 (Radio Operator), 212 (Teletype Operator), 222 (Terminal Equipment Tech) and 223 (Teletype Tech)[1-2].

2. MOCs 221, 224 and 231 are currently employed at all Wings in support of telecommunications and air operations. They are also integrated into deployable elements such as 8 Air Communications and Control Squadron (8 ACCS) and 4 Airfield Engineering Squadron (4 AES) and must also provide support to NORAD and AWACS elements as well as rotations at CFS Alert, Canadian Coastal Radars (CCRs), Forward Operating Location (FOL) maintenance, training and exercises. All of the non Air Command occupations play an important role in an integrated Canadian Forces telecommunications capability. MOC 211 (Rad Ops) are employed at tactical helicopter squadrons and are integral to the units' deployed operations. For other deployed air operations, the MOC 211 requirements are sourced by NDHQ J6. MOC 211 personnel have in the past played an active role in 8 ACCS deployments such as OP BOXTOP, OP SCOTCH and OP PIVOT, however their utilization together with MOCs 052, 212 and 222 in a fully deployable sense is only realized when a contingency operation such as OP SPECTRE is activated.

3. With the mandate for the Air Force to deploy on contingency operations on short notice, the impact of the number of taskings on C&E personnel and their ability to support the Air Command mission needs to be examined. As such, the Deputy Chief of Staff Operational Research was asked to determine the optimum number of Regular Force C&E personnel required to effectively support all deployments and taskings including Operational Plans (Oplans), annual training and exercises [1].

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[1] Presently, most of the personnel in these occupations are under the control of Director Information Systems Operations (DISO) and Land Forces Command (LFC).

[2] Effective 1 Jan 96, MOCs 221, 222, 223, 224 and 231 will no longer exist and will have been effectively restructured into three new C&E MOCs: MOC 225 (Strategic Information Systems); MOC 226 (Aerospace Telecommunications and Information Systems); and MOC 227 (Land Communications and Information Systems).

2 - METHODOLOGY

4. The methodology used to determine the optimum number of C&E personnel is based on stochastic modelling of real life taskings plus contingency plans[3]. The establishment strength effective 11 Apr 95 (Tables 1a and 1b) was used as the baseline number of C&E personnel. Personnel structure models were then built based upon the following assumptions:

a. tours out of country (8 ACCS deployments, El Gorah and the Oplans) and to CFS Alert will be six months in duration with 12 months in Canada before the next out-of-country tour. When personnel return, they are accorded a rest of two months before they become deployable (in Canada only);

b. 8 ACCS deployments that are not undertaken annually (e.g., OP AIRBRIDGE, CANBAT I, OP LANCE, OP SCOTCH and OP PIVOT) are given a 50% probability of undertaking a similar type of deployment. All remaining 8 ACCS deployments follow the typical annual deployment history;

c. exercises and training commitments are based on historical yearly values for the number of personnel and the duration of the engagement;

d. all deployments, taskings, exercises and training could overlap to some extent in the overall statistical process; and

e. Oplan deployments are based on the Operational Personnel Risk Assessment Model (OPRAM) planning factor assumptions effective 23 Nov 95.

[3] See reference 2 for a similar study done for Construction Engineering personnel.

Establishment

5. Tables 1a and 1b show the establishment for the 8 C&E NCM and officer MOCs respectively. In total, the establishment on 11 Apr 95 consisted of 561 NCMs in the 8 C&E MOCs and 76 officers in the classification: 42C (CELE).

MILITARY OCCUPATION	C-P	MCPL	SGT	WO	MWO	CWO	TOTAL
AIR COMMAND OCCUPATIONS							
221 (Rad Tech)	130	68	41				239
224 (Comm Tech)				21	9	4	34
231 (Rdr Tech)	103	74	38	24	14	5	258
NON AIR COMMAND OCCUPATIONS							
052 (Linemen)				1		1	2
211 (Rad Op)	11	8	3	1			23
212 (Tel Op)			1				1
222 (TE Tech)	1	1					2
223 (Tel Tech)	2						2
TOTAL	247	151	83	47	23	10	561

Table 1a. C&E Establishment for NCMs

MILITARY OCCUPATION	C-LT	CAPT	MAJ	LCOL	COL		TOTAL
42C	15	41	20				76

Table 1b. C&E Establishment for Officers

Establishment

5. Tables 1a and 1b show the establishment for the 8 C&E NCM and officer MOCs respectively. In total, the establishment on 11 Apr 95 consisted of 561 NCMs in the 8 C&E MOCs and 76 officers in the classification: 42C (CELE).

MILITARY OCCUPATION	C-P	MCPL	SGT	WO	MWO	CWO	TOTAL
AIR COMMAND OCCUPATIONS							
221 (Rad Tech)	130	68	41				239
224 (Comm Tech)				21	9	4	34
231 (Rdr Tech)	103	74	38	24	14	5	258
NON AIR COMMAND OCCUPATIONS							
052 (Linemen)				1		1	2
211 (Rad Op)	11	8	3	1			23
212 (Tel Op)			1				1
222 (TE Tech)	1	1					2
223 (Tel Tech)	2						2
TOTAL	247	151	83	47	23	10	561

Table 1a. C&E Establishment for NCMs

MILITARY OCCUPATION	C-LT	CAPT	MAJ	LCOL	COL		TOTAL
42C	15	41	20				76

Table 1b. C&E Establishment for Officers

8 ACCS Deployments

6. Figure 1 illustrates the deployment, tasking, training and exercise schemes under consideration.

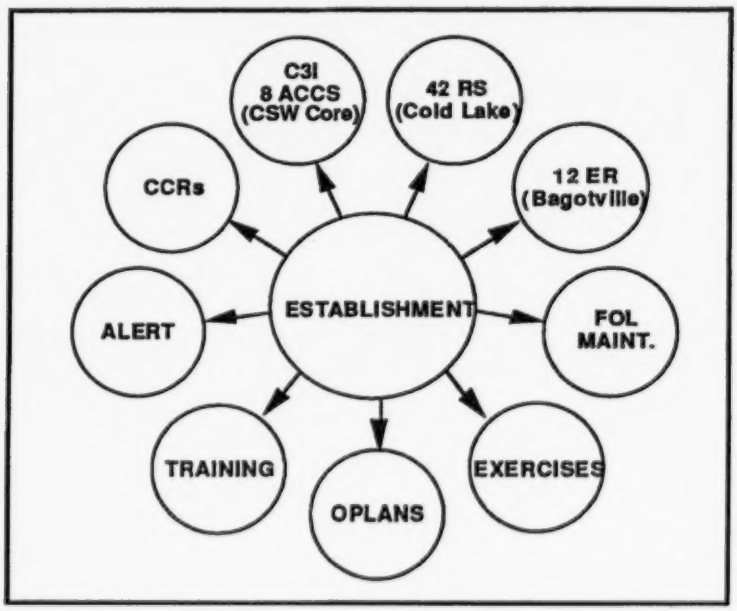


Figure 1. Communications and Electronics personnel deployment scheme

7. 8 ACCS, located at 8 Wing Trenton, is deployable within 6 hours to provide tactical communications for command and control, air traffic control, navigational aids, and airfield facilities. As shown in Table 2, 8 ACCS has a military establishment of 38, of which 27 are C&E personnel. 8 ACCS personnel spend most of their time on various deployments throughout the year ranging from national and international exercises such as EX MOUNTAINVIEW, OP BOXTOP and AMALGAM WARRIOR to six month United Nations (UN) tours such as OP AIRBRIDGE and OP PIVOT.

MOC	C-P	MCPL	SGT	WO	MWO	CWO	TOTAL
221 (Rad Tech)	5	3	3				11
224 (Comm Tech)				1	1		2
231 (Rdr Tech)	4	4	1	1			10
052 (Linemen)							0
211 (Rad Op)	1		1				2
212 (Tel Op)							0
222 (TE Tech)							0
223 (Tel Tech)							0
Total	10	7	5	2	1	0	25
OFFICERS	C-LT	CAPT	MAJ	LCOL	COL		TOTAL
42C		1	1				2

Table 2. 8 Air Communications and Control Squadron Establishment

8. The calendar year is broken up into 52 weekly intervals with deployments, exercises or training starting on a particular week and lasting for an assigned period of time of minimum one week (See Table A-1 (Annex A) for the calendar used in this study). Table B-1 (Annex B) details a typical 8 ACCS deployment schedule. EX MOUNTAINVIEW, BOXTOP I, II and III, EX AMALGAM WARRIOR and the Quinte International Air Show (QIAS) occur annually (EX AMALGAM WARRIOR occurs twice per year). Except for OP AIRBRIDGE and OP PIVOT, the remainder are typical exercises that are given a 50% chance of taking place each year based on a random choice between 0 and 1. If chosen, the deployment is modelled such that it leaves and returns (also randomly determined) sometime before Christmas, e.g., in the first year, an OP SCOTCH type deployment will leave for two months (9 weeks) sometime between week 1 and week 41 inclusive. Returnees in all the above scenarios are given two weeks rest before becoming fully deployable again (i.e., available for out-of-country deployments).

9. OP AIRBRIDGE and OP PIVOT type deployments are six months in duration with twelve months in Canada before the next out-of-country tour. In the four year period that is modelled, OP AIRBRIDGE is given a 50% chance of leaving during the first 52 weeks of each two year period. Only one rotation is modelled. An OP PIVOT type deployment, on the other hand, is given a 50% chance of leaving during the first 52 weeks of the first year only. In this scenario, two rotations are modelled.

10. When personnel return after six months out of country, they are accorded a rest of two months before they can be considered deployable again for other taskings within Canada. Only after twelve months are they considered fully deployable again.

Mathematical Model for 8 ACCS Deployments

11. For NCMs, the basic equations that govern deployments and returning personnel are[4]

$$R^1_{ij}(t) = S^1_{ij}(t) \mp C_{ij} \quad ,i=1,\ldots,8, \quad j=1,\ldots,6 \quad , \qquad (1)$$

$$R^2_{ij}(t) = S^2_{ij}(t) \pm C_{ij} \quad ,i=1,\ldots,8, \quad j=1,\ldots,6 \quad , \qquad (2)$$

$$R^3_{ij}(t) = S^3_{ij}(t) \pm C_{ij} \quad ,i=1,\ldots,8, \quad j=1,\ldots,6 \quad , \qquad (3)$$

where in equation (1), $R^1_{ij}(t)$ represents the number of personnel of NCM MOC i and rank j that remain fully deployable following a deployment at time t (in weeks), $S^1_{ij}(t)$ represents the number of personnel prior to the deployment and C_{ij} is a constant given by the number of personnel that make up the deployment (e.g., see Table B-1). In equation (2), the term $R^2_{ij}(t)$ represents the number of personnel that have returned from a deployment but are not deployable for at least two months. The term $S^2_{ij}(t)$, as for the term $S^1_{ij}(t)$, represents the prior condition. In equation (3), the term $R^3_{ij}(t)$ represents the number of personnel who are deployable in Canada only. A steady state is obtained only through repeated applications of equations (1) through (3).

12. The signs of equations (1) – (3) are defined in the following order assuming a six month deployment:

a. Equation (1) → (–): Deployment ($t = 0$);

b. Equation (2) → (+): Return after six months and rest for two months;

c. Equation (3) → (+); Equation (2) →(–): Return from rest and remain deployable in Canada for the next ten months; and

d. Equation (3) → (–); Equation (1) → (+): After ten months, personnel become fully deployable.

13. Figure 2 illustrates the deployment and return of personnel to Air Command bases. Personnel available to work on each base are determined by the number that are fully deployable as well as those that have recently returned from a deployment and are therefore not deployable for a period of time.

[4]A similar set of equations exists for Officers.

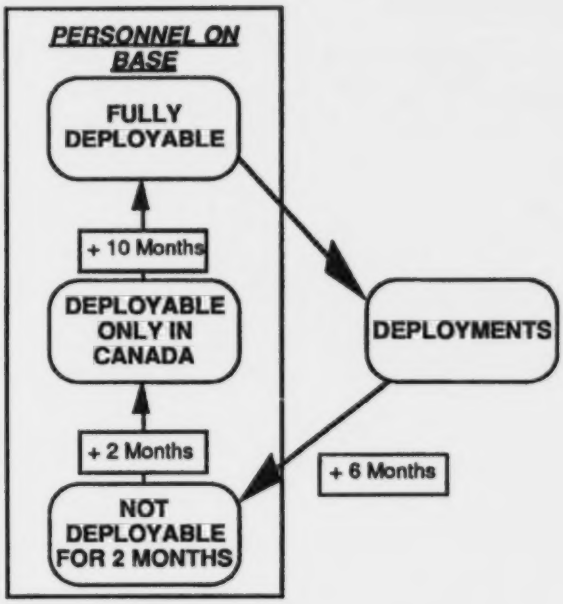


Figure 2. Scheme to illustrate the deployment and return of Air Command Communications and Electronics personnel

12e ER (Escadron de Radar) Bagotville and 42 Radar Squadron (Cold Lake)

14. 12e ER Bagotville and 42 Rdr operate and maintain two control and surveillance radars (TPS-70). They are both deployable units, however, 42 Rdr does not deploy often due to its requirement for support to flying operations at Primrose Lake Evaluation Range (PLER) and Jimmy Lake Range. Like 8 ACCS, these units require augmentation from time to time. The deployment history for 42 Rdr and 12e ER are outlined in Tables B-2 and B-3 respectively in Annex B. Because of the short duration of these deployments, personnel are accorded a rest of only two weeks when they return.

Canadian Coastal Radars

15. There are four Canadian Coastal Radars (CCRs) in Canada: Holberg, B.C., Sydney, N.S., Barrington, N.S., and Gander, NFLD. These units are supported by Gander, Greenwood and Comox. Table 3 shows the maintenance schedule for each of the CCRs. Each trip lasts for 1 week and requires 3 technicians: 1 x MCpl (231) and 2 x Cpl (231). Departure dates were randomly determined in the model. For example, the maintenance schedule for Holberg takes place each February (weeks 6–9), May (18–22),

August (31–35) and November (45–48). Radar Techs depart at some time during the month and return after 1 week.

Canadian Coastal Radar	Dates (Weeks)
Holberg	6–9; 18–22; 31–35; 45–48
Gander	6–9; 18–22; 31–35; 45–48
Sydney	1–5; 14–17; 27–30; 40–44
Barrington	10–13; 23–26; 36–39; 49–52

Table 3. Canadian Coastal Radars maintenance schedule

FOL Maintenance/Deployments

16. FOL maintenance is provided by 4 Wing Cold Lake and 3 Wing Bagotville. Cold Lake is responsible for Inuvik, Rankin Inlet and Yellowknife. Bagotville is responsible for Iqaluit. Due to manpower constraints, Cold Lake can only activate two of the three FOLs simultaneously.

17. Table B-4 (Annex B) shows the deployment schedule for FOL maintenance. Personnel from Cold Lake deploy to a maximum of 2 FOLs (randomly determined) at any one time for 24/7 operations. For the purpose of this study, personnel from Bagotville deploy to the FOLs at approximately the same time as Cold Lake. Two deployments are scheduled annual maintenance: 2 weeks February (leave between week 6 and week 8), April (14–16); and 3 deployments are for unscheduled periodic maintenance: 1 week June (23–26), August (31–35), November (45–48).

CFS Alert Deployments

18. Air Command is committed to staff four positions in CFS Alert: 1 x Cpl (221), 1 x MCpl (221), 1 x Sgt (221) and 1 x WO (224). These positions are filled on a rotation basis of 6 months duration. Figure 2 and equations (1–3) therefore apply. Personnel usually deploy in Sep/Oct and return in Mar/Apr. Therefore, the starting date for deployment in year 1 is randomly determined to be between weeks 36 – 42.

Training

19. The vast variety of equipment used by Air Command units demands a heavy training schedule and significant involvement by the units. The total training commitment could be placed into two categories: instructors and students. While TRACS STU is the main training unit, there is some training conducted at 9 Wing Gander (Coastal radar). However, the latter has only two dedicated PYs compared to 34 at TRACS STU.

20. Tables B-5 and B-6 (Annex B) outline the annual 200 series MOC Tech and CELE training schedules respectively. When personnel return from training, they are considered to be immediately fully deployable. Training such as JLC, SLC, basic trades or classification training and TQ5 training has not been included. Travel time has also not been included.

Exercises

21. Annual training exercises create a significant activity at a sponsoring Wing, usually for short duration's. As well, the requirement for general augmentations surface on a regular basis. It is expected that these activities would continue while an Oplan is active. Resupply of CFS Alert, manning of CFS Alert or operational training (Maple Flag) in preparation for deployment must continue.

22. Table B-7 (Annex B) outlines the annual exercise schedule for 200 series MOCs.

Operational Plans

23. Oplans have been developed based on realistic scenarios for all aspects of the operational Air Force. For planning purposes there are five activities (Fighters, Maritime Patrol Aircraft (MPA), Tactical Helicopters (Tac Hel), Land Forces Command (LFC) and Airlift) each with a respective Oplan associated with it. Table 4 lists the number of aircraft associated with each Oplan, the level of support required and the number of perceived rotations. The five Oplans are:

a. SPECTRE/IGLOO: Deployment of up to 36 CF188 aircraft to a low–to–medium threat environment. Deployment of CF188 and Air Defence Operations teams to FOLs and North Warning System (NWS) sites.

b. ORCA: Deployment of up to 6 MPAs for surveillance operations.

c. FORTUNE: Deployment of up to 8 Utility Tactical Transport Helicopters (UTTH) for tactical helicopter operations.

d. SABRE: Radar support to LFC for low-level air defence operations.

e. CONVEYOR: Deployment of up to 8 CC130 Hercules for tactical airlift operations.

# of A/C	Support	Rotations
Fighters/SPECTRE/IGLOO		
6	MOB	4
6	DOB	4
12	MOB	4
12	DOB	4
18	MOB	4
18	DOB	3
18	BB*	1
36	MOB	1
36	DOB	1
36	BB*	1
MPA/ORCA		
2	MOB	2
2	DOB	2
4	MOB	2
4	DOB	2
6	MOB	2
6	DOB	2
Tac Hel/FORTUNE		
3	DOB	2
4	BB	2
6	BB	2
8	BB	2
LFC/SABRE		
24	Svc Bn	1
Airlift/CONVEYOR		
8	MOB	1
8	DOB	1
8	BB	1

MOB = Main Operating Base, DOB = Deployed Operating Base, BB = Bare Base
* SPECTRE BB is limited to one rotation followed by 18 A/C DOB for 3 rotations

Table 4. Oplan planning assumptions

24. Table 4 was extracted from OPRAM planning assumptions dated 23 Nov 95 [3]. The OPRAM (Operational Personnel Risk Assessment Model) was developed by the Operational Research Division "...

to find a practical method to assess the risk of air force personnel shortages." [4]. OPRAM achieves its goal by modelling the full range of activities associated with each Oplan and simulating the uncertainties about which Oplans (or portions thereof) that are activated. OPRAM then relates each iteration of the simulation to all available personnel resources to establish the shortages within each MOC.

25. Table B-8 (Annex B) shows the rank and communication occupation composition for all Oplan deployments. A surge capability is modelled by deploying the required personnel for initial setup and return after two months. After a further two weeks rest, the personnel are considered fully deployable.

26. As Table 4 shows there are ten sub-oplans for OP SPECTRE which include four different sizes of deployments (6, 12, 18 and 36 aircraft squadrons), three different levels of support (Bare Base = self supporting, Deployed Operating Base = autonomous with some support and Main Operating Base = integrated with all support required) and three levels of rotations (4, 3 and 1). Since the same composition of personnel are deployed for OP SPECTRE regardless of the level of support (Table B-8), the probabilities associated with deployments *within* OP SPECTRE are based solely on the number of rotations. Therefore, if in the simulation OP SPECTRE is chosen, then there is a 7/10 chance that four rotations will occur (included are 18/BB and 36/BB which are limited to one rotation followed by an 18 A/C DOB for three rotations for a total of four rotations), a 1/10 chance for three rotations and a 2/10 chance for one rotation. Similarly, since OP ORCA has two distinct personnel compositions, one for MOB and the other for DOB (Table B-8), Table 4 indicates that there is a 50/50 chance that either an MOB or DOB team will be deployed. For CONVEYOR, there is one team for MOB and one for DOB/BB. Therefore, Table 4 shows that there is a 1/3 chance that an MOB team will be deployed and a 2/3 chance for a DOB/BB team.

27. Deputy Chief Of Staff Plans & Requirements (DCOS P&R) asserts that the maximum number of Oplans that can be activated simultaneously is three. If each Oplan scenario has the same probability of being activated, i.e., $p = 0.2$ ($q = 1 - p$ for not activating the Oplan) for each of five Oplans, then the number of plans activated in a given year is defined by the binomial distribution, i.e., for one Oplan,

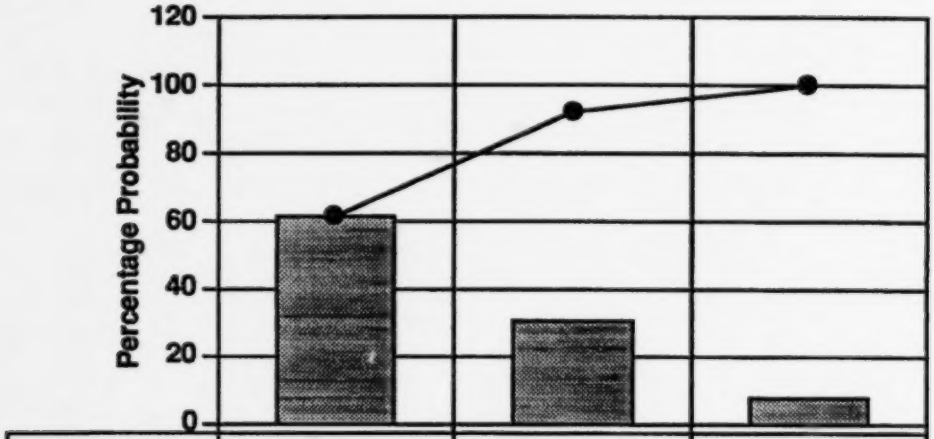
$$\begin{aligned} P(X) &= \frac{N!}{X!(N-X)!} p^X q^{N-X}, \\ &= \frac{5!}{1!4!} 0.2 \times 0.8^4 \quad , N = 5; X = 1, \\ &= 0.4096 \quad , \end{aligned} \tag{4}$$

or there is a 40.96% chance that only one Oplan will be activated.

28. The probability that two Oplans will be activated is then $10 \times 0.2^2 \times 0.8^3 = 0.2048$. And finally, the probability that three Oplans will be activated in a given year is $10 \times 0.2^3 \times 0.8^2 = 0.0512$. Table 5 shows the probabilities of activation for each individual Oplan and their combinations. Figure 3 shows the results of Table 5 in a graphical format.

# of Oplans	OPLAN COMBINATION	P(A) %	P(A) % Weighted	P(A) % Cumulative
1	Spectre	8.19	12.31	12.31
1	Orca	8.19	12.31	24.62
1	Fortune	8.19	12.31	36.93
1	Sabre	8.19	12.31	49.24
1	Conveyor	8.19	12.31	61.55
2	Spectre+Orca	2.05	3.08	64.63
2	Spectre+Fortune	2.05	3.08	67.71
2	Spectre+Sabre	2.05	3.08	70.79
2	Spectre+Conveyor	2.05	3.08	73.87
2	Orca+Fortune	2.05	3.08	76.95
2	Orca+Sabre	2.05	3.08	80.03
2	Orca+Conveyor	2.05	3.08	83.11
2	Fortune+Sabre	2.05	3.08	86.19
2	Fortune+Conveyor	2.05	3.08	89.27
2	Sabre+Conveyor	2.05	3.08	92.35
3	Spectre+Orca+Fortune	0.51	0.766	93.12
3	Spectre+Orca+Sabre	0.51	0.766	93.88
3	Spectre+Orca+Conveyor	0.51	0.766	94.65
3	Spectre+Fortune+Sabre	0.51	0.766	95.41
3	Spectre+Fortune+Conveyor	0.51	0.766	96.18
3	Spectre+Sabre+Conveyor	0.51	0.766	96.95
3	Orca+Fortune+Sabre	0.51	0.766	97.71
3	Orca+Fortune+Conveyor	0.51	0.766	98.48
3	Orca+Sabre+Conveyor	0.51	0.766	99.24
3	Fortune+Sabre+Conveyor	0.51	0.766	100.00
	Total	66.55	100.00	

Table 5. Oplan combinations and probability of activation



# Oplans Activated	1	2	3
P(Activated)	61.55%	30.80%	7.66%
Cumulative %	61.55%	92.35%	100.00%

Figure 3. Probability that 1 – 3 Oplans are activated

3 - RESULTS AND DISCUSSION

29. The simulation consists of 100 iterations with each iteration modelling personnel flow for a four year period[5]. Results are given in terms of the number of personnel that are fully deployable based on the activation of 0, 1, 2 or 3 Oplans simultaneously. If $n\,(n=1,2,3)$ Oplans are activated within a simulation run, each Oplan, or combination of Oplans, has the same probability of being activated as described in Table 5.

30. As an example, the results for activating only one Oplan may be found in Annexes C–E. They are plotted in three formats:

a. total personnel available for work or deployments by MOC and rank;

b. total personnel available for work or deployments by MOC; and

[5] There is no strict rationale for choosing four years as opposed to three or five. The idea was to factor in enough rotations for lengthy deployments without sacrificing the impact of training schedules, exercises and short deployments. Regardless, since the Oplans are only activated during year 1, a steady state approximation is not obtained until at least two years have expired.

c. total personnel available for work or deployments by NCM or officer status.

31. Each graph represents the number of C&E personnel on Air Command Bases that are fully deployable. This does not include personnel who have recently returned from a deployment and are considered to be "at rest" nor does it include personnel that are available for deployments in Canada only (see Figure 2).

32. As Annex C shows, certain ranks within MOCs 221, 224, 231, 211 and 42C exhibit a cyclical trend. For the case of MOCs 221 and 231 with ranks Cpl, MCpl and Sgt, and MOC 42C with ranks Lt and Capt, this is largely due to training commitments where personnel are required to attend training courses and return within the 12 month period. The remaining cyclical trends are based on 8 ACCS, 12e ER Bagotville and 42 Rdr deployments. For all MOCs, large dips in the curves are due to the Oplans being activated within the first 52 weeks with personnel deploying for the number of rotations specified in Table 4.

33. In most cases, the upper bound on the statistical spread was maximized at the establishment value for that particular MOC and rank. For each graph, an upper/lower bound in the number of available personnel was taken as the mean value of the data for the ± 1 standard deviation curves in the period 1–3 years inclusive. This approximates a steady state flow of personnel. Best and worst case estimates were, therefore, evaluated at these mean values of the upper and lower bounds in the statistical spread respectively.

34. Figure 4 presents a good illustration of the results for the four C&E ranks of MOC 211 (Rad Op) (1 Oplan activated). The negative "spikes" in the ranks C-P, MCpl and Sgt represent OP BOXTOP during weeks 16, 36 and 43 for a period of two weeks (Table B-7). The large dips in the curves for each rank result from the large demands imposed on MOC 211 from Ops SPECTRE, ORCA and CONVEYOR.

35. For each rank, the statistical spread, i.e., the highest and lowest points in the cycle, for the number of available personnel is estimated to be

$$\begin{aligned} C-P &= -30, 10 \quad , \\ MCPL &= -3, 8 \quad , \\ SGT &= 0, 2 \quad , \\ WO &= 0, 1 \quad , \end{aligned} \tag{5}$$

where the two numbers represent the lower and upper bounds respectively.

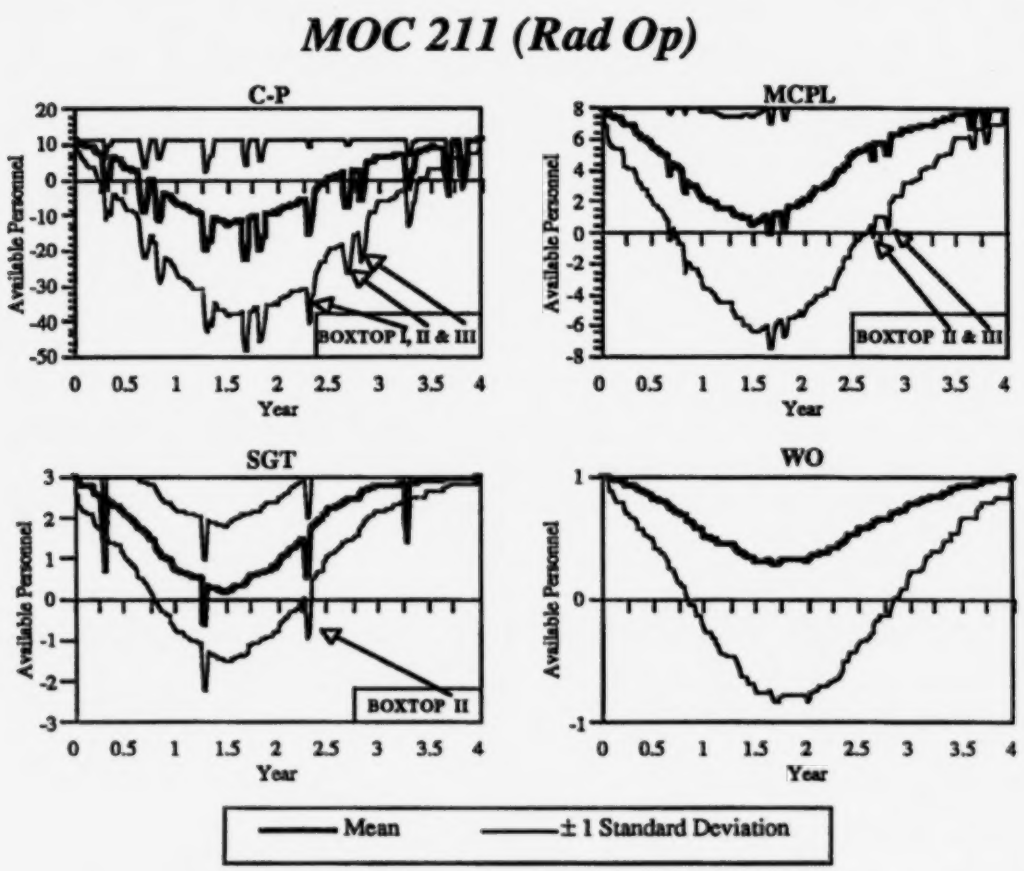


Figure 4. Fully deployable MOC 211 personnel (1 Oplan Activated)

36. The resultant of equation (5) yields a total of (-33, +21). This works out to (-143%, 91%) of the establishment value listed in Table 1a, i.e., the best case would be 91% of establishment and the worst case would be -143% of establishment. The best case could be interpreted as the activation of an Oplan that requires little or no radio operators such as SABRE (0). On the other hand, the worst case is interpreted as the activation of an Oplan that requires large numbers of radio operators, i.e., ORCA–DOB (45). All other Oplans, or combinations of Oplans, fall between these two extremes.

37. The statistical results for the activation of 0, 1, 2 or 3 Oplans simultaneously are listed in Tables 6–9. For each MOC and rank, the lower and upper bounds in the cycle are given. The results for each MOC are totaled under the last column. Therefore, using the actual C&E establishment values from Tables 1a and 1b, the "Percent of Establishment (POE)" in the lower and upper bounds may be calculated. Table 10 lists the spread in the POE for the total number of personnel from each MOC that are fully deployable.

MILITARY OCCUPATION	C-P	MCPL	SGT	WO	MWO	CWO	TOTAL
221 (Rad Tech)	108, 114	53, 56	32, 34				193, 204
224 (Comm Tech)				15, 17	9, 9	4, 4	28, 30
231 (Rdr Tech)	86, 88	60, 62	30, 31	23, 23	13, 14	5, 5	217, 223
052 (Linemen)				1, 1		1, 1	2, 2
211 (Rad Op)	8, 9	8, 8	2, 3	1, 1			19, 21
212 (Tel Op)			1, 1				1, 1
222 (TE Tech)	1, 1	1, 1					2, 2
223 (Tel Tech)	2, 2						2, 2
							Total NCM = 464, 485
	C-LT	CAPT	MAJ	LCOL	COL	Total Officers	
42C	12, 12	37, 39	19, 20			68, 71	

Table 6. Statistical spread for the number of C&E personnel that are fully deployable: No Oplans Activated

MILITARY OCCUPATION	C-P	MCPL	SGT	WO	MWO	CWO	TOTAL
221 (Rad Tech)	82, 116	35, 59	29, 33				146, 208
224 (Comm Tech)				15, 16	9, 9	2, 4	26, 29
231 (Rdr Tech)	64, 90	46, 63	25, 32	20, 23	13, 14	5, 5	173, 227
052 (Linemen)	-11, 0	-3, 0	-3, 0	0, 1	0, 0	1, 1	-16, 2
211 (Rad Op)	-30, 10	-3, 8	0, 2	0, 1			-33, 21
212 (Tel Op)		-2, 0	-1, 1				-3, 1
222 (TE Tech)	0, 1	-1, 1					-1, 2
223 (Tel Tech)	1, 2	-1, 0					0, 2
							Total NCM = 292, 492
	C-LT	CAPT	MAJ	LCOL	COL	Total Officers	
42C	12, 12	35, 39	18, 20			65, 71	

Table 7. Statistical spread for the number of C&E personnel that are fully deployable: 1 Oplan Activated

MILITARY OCCUPATION	C-P	MCPL	SGT	WO	MWO	CWO	TOTAL
221 (Rad Tech)	67, 110	25, 54	28, 32				120, 196
224 (Comm Tech)				14, 16	9, 9	2, 4	25, 29
231 (Rdr Tech)	50, 84	38, 59	22, 30	18, 22	12, 14	5, 5	145, 214
052 (Linemen)	-17, 0	-5, 0	-4, 0	-1, 1	0, 0	1, 1	-26, 2
211 (Rad Op)	-50, 5	-9, 6	-1, 2	-1, 1			-61, 14
212 (Tel Op)		-2, 0	-1, 1				-3, 1
222 (TE Tech)	-1, 1	-1, 1					-2, 2
223 (Tel Tech)	1, 2	-1, 0					0, 2
							Total NCM = 198, 460
	C-LT	CAPT	MAJ	LCOL	COL	Total Officers	
42C	12, 12	33, 38	17, 20			62, 70	

Table 8. Statistical spread for the number of C&E personnel that are fully deployable: 2 Oplans Activated

MILITARY OCCUPATION	C-P	MCPL	SGT	WO	MWO	CWO	TOTAL
221 (Rad Tech)	55, 103	17, 50	26, 32				98, 185
224 (Comm Tech)				14, 16	9, 9	1, 4	24, 29
231 (Rdr Tech)	35, 75	29, 53	19, 28	16, 21	12, 14	5, 5	116, 196
052 (Linemen)	-21, -2	-6, -1	-5, 0	-1, 1	0, 0	1, 1	-32, -1
211 (Rad Op)	-70, -4	-14, 3	-2, 1	-2, 1			-88, 1
212 (Tel Op)		-3, 0	-2, 1				-5, 1
222 (TE Tech)	-1, 1	-2, 1					-3, 2
223 (Tel Tech)	1, 2	-1, 0					0, 2
							Total NCM = 110, 415
	C-LT	CAPT	MAJ	LCOL	COL	Total Officers	
42C	12, 12	32, 37	17, 20			61, 69	

Table 9. Statistical spread for the number of C&E personnel that are fully deployable: 3 Oplans Activated

MOC	PERCENT OF ESTABLISHMENT (%)			
	0 OPLANS	1 OPLAN	2 OPLANS	3 OPLANS
221 (Rad Tech)	81, 85	61, 87	50, 82	41, 77
224 (Comm Tech)	82, 88	76, 85	74, 85	71, 85
231 (Rdr Tech)	84, 86	67, 88	56, 83	45, 76
052 (Linemen)	100, 100	-800, 100	-1300, 100	-1600, -50
211 (Rad Op)	83, 91	-143, 91	-265, 61	-383, 4
212 (Tel Op)	100, 100	-300, 100	-300, 100	-500, 100
222 (TE Tech)	100, 100	-50, 100	-100, 100	-150, 100
223 (Tel Tech)	100, 100	0, 100	0, 100	0, 100
Total NCMs	**83, 86**	**52, 88**	**35, 82**	**20, 74**
42C	89, 93	86, 93	82, 92	80, 91
Total Officers	**89, 93**	**86, 93**	**82, 92**	**80, 91**

Table 10. Lower and upper bounds to the percent of the current C&E Establishment for the number of personnel that are fully deployable

38. Figures 5a and 5b show Table 10 in a graphical format for the upper and lower bounds in the statistical spread respectively. Because we are dealing with such small establishment values for MOCs 052, 212 and 222, the use of more than two individuals will immediately drop the lower bound in the POE to a large negative value[6]. Between SPECTRE, ORCA and CONVEYOR (non-surge) a total of 23 Linemen (052), 111 Rad Op (211), 6 Tel Op (212) and 2 TE Tech (222) personnel are utilized although establishment data specifies that only 2 Linemen, 23 Rad Op, 1 Tel Op and 2 TE Tech personnel are available.

39. The greatest use of personnel resources occurs when three Oplans are activated simultaneously. In a worst case situation (Table 9), there are only 110 NCMs (20 POE) that are considered fully deployable. Notwithstanding the fact that DCOS P&R requires a maximum activation of only three Oplans simultaneously vice five, we should not lose sight of the impact of Oplan activation, to any degree, on those C&E occupations that are required to support the Oplans but do not have the existing personnel assets to support all deployments, taskings and training commitments and still provide support to Air Command Wings. These are MOCs 052, 211, 212 and 222 which drop to large negative values if only one of the major Oplans (SPECTRE or ORCA) is activated[7].

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[6] In Figures 5a and 5b, the arrows directed below -100% indicate values for the POE that are « -100% as shown in Table 10.

[7] If no Oplans were activated, there would be essentially no impact on MOCs 052, 211, 212, 222 and 223. MOC 211, in a worst case scenario, would be down to approximately 19 radio operators from an initial 23.

MOC	PERCENT OF ESTABLISHMENT (%)			
	0 OPLANS	1 OPLAN	2 OPLANS	3 OPLANS
221 (Rad Tech)	81, 85	61, 87	50, 82	41, 77
224 (Comm Tech)	82, 88	76, 85	74, 85	71, 85
231 (Rdr Tech)	84, 86	67, 88	56, 83	45, 76
052 (Linemen)	100, 100	-800, 100	-1300, 100	-1600, -50
211 (Rad Op)	83, 91	-143, 91	-265, 61	-383, 4
212 (Tel Op)	100, 100	-300, 100	-300, 100	-500, 100
222 (TE Tech)	100, 100	-50, 100	-100, 100	-150, 100
223 (Tel Tech)	100, 100	0, 100	0, 100	0, 100
Total NCMs	83, 86	52, 88	35, 82	20, 74
42C	89, 93	86, 93	82, 92	80, 91
Total Officers	89, 93	86, 93	82, 92	80, 91

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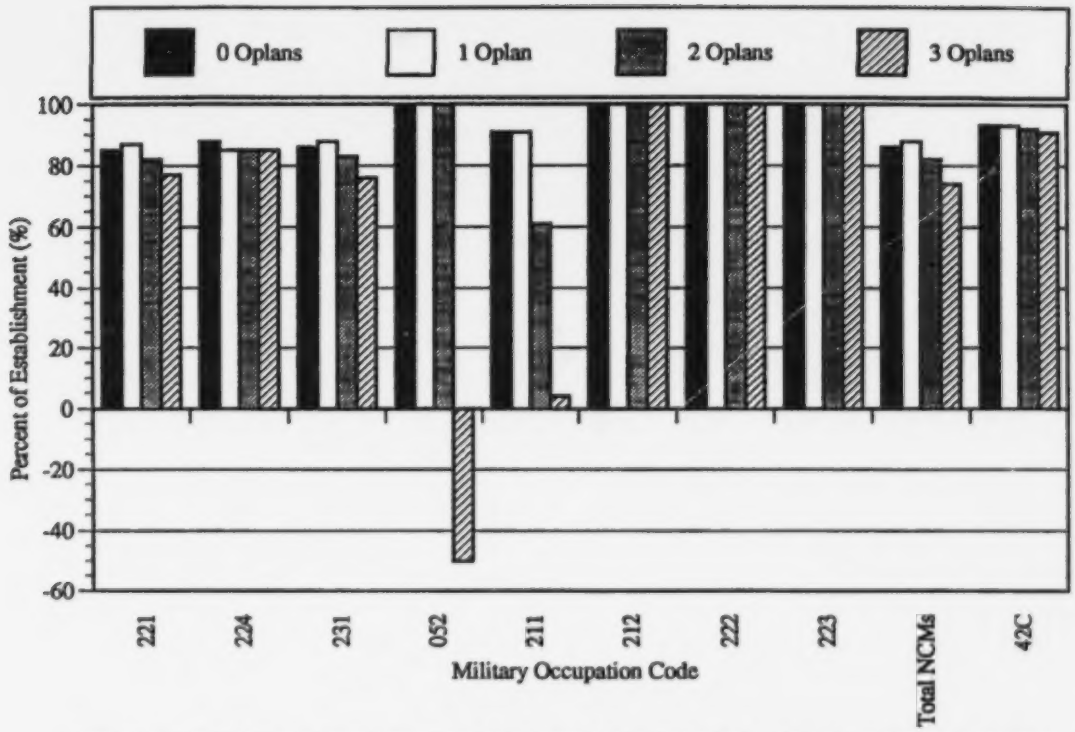

Figure 5a. Upper bound to mean percent of C&E establishment for each MOC (0 – 3 Oplans Activated)

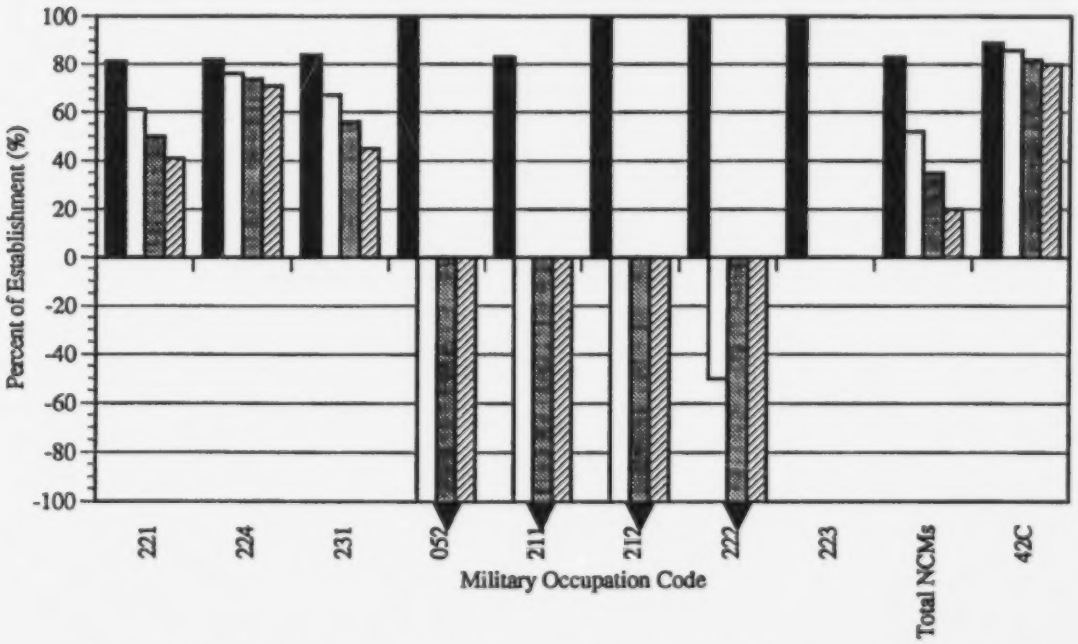

Figure 5b. Lower bound to mean percent of C&E establishment for each MOC (0 – 3 Oplans Activated)

4 - CONCLUSIONS

40. The results of this study show, over time, the impact of deployments, taskings, training, exercises and the Oplans on the C&E military occupations.

41. From what has been discussed, it is clear that existing personnel assets, as they are currently distributed, cannot support all deployments (including Oplans), taskings and training commitments at any one particular time and still provide support to Air Command Wings. Table 11 summarizes the impact of Oplan activation on C&E NCMs and Officers. The two columns labelled " Fully Deployable" denote the total number of personnel (lower and upper bounds) that are considered fully deployable as described in para. 31 and Figure 2; columns labelled "POE" denote the "Percent of Establishment" (Tables 1a & 1b) that are fully deployable; and columns labelled "Not Deployable" represent the remaining personnel, i.e., those who are either in the field, at rest or are not deployable outside of Canada.

Max # of Oplans Activated	NCMs			Officers		
	Fully Deployable	POE	Not Deployable	Fully Deployable	POE	Not Deployable
0	[464, 485]	83%, 86%	[97, 76]	[68, 71]	89%, 93%	[8, 5]
1	[292, 492]	52%, 88%	[269, 69]	[65, 71]	86%, 93%	[11, 5]
2	[198, 460]	35%, 82%	[363, 101]	[62, 70]	82%, 92%	[14, 6]
3	[110, 415]	20%, 74%	[451, 146]	[61, 69]	80%, 91%	[15, 7]

Table 11. Impact of Oplan activation on C&E NCMs and Officers

42. As the number of activated Oplans increases, the number of fully deployable personnel decreases as expected[8]. The decrease in the mean number of personnel is linear yet the statistical spread about the mean exhibits a non-linear trend as the number of Oplans increases. This is largely due to large variations about the mean in the number of fully deployable personnel. For example, according to elementary combinatorial theory, there are exactly five ways of choosing 1 out of 5 Oplans; ten ways of choosing 2 out of 5 Oplan and ten ways of choosing 3 out of 5 Oplans. Therefore, we would naturally expect the standard

[8] The case of 1 Oplan (Upper Bound: NCMs) > 0 Oplans (Upper Bound: NCMs) is due to large variations about the mean, i.e., 1 Oplan ($\mu = 400$, $\sigma = 93$), 0 Oplans ($\mu = 474$, $\sigma = 8$).

deviation to increase (or decrease) proportionally as the number of ways of combining Oplans increases (or decreases).

43. Regardless of the number of Oplans that might be activated, the number of personnel in Non-Air Command occupations must be accounted for in order to make the Oplans a realistic undertaking. With probabilities as high a 61% for activating one Oplan, the Non-Air Command occupations would have an immediate shortage of at most 53 personnel. If three Oplans were activated, the shortage increases to 128 personnel with MOC 211 (Rad Op) presenting the greatest shortage.

44. One way to alleviate these shortages within the Non-Air Command occupations (and in particular MOC 211) would be the re-skilling of non-operator personnel. For example, Figure 6 compares, for the upper curve, the summation of the lower bounds for MOCs 221, 224, 231, 052, 222 and 223 (technician occupations) with the lower bound for MOC 211 (operator occupation) for three Oplans activated simultaneously. The mean values for the upper and lower curves over the period 1–3 years are +204 and -87 respectively. Therefore, shortages for MOC 211 personnel can be more than made up through re-skilling of the technician occupations.

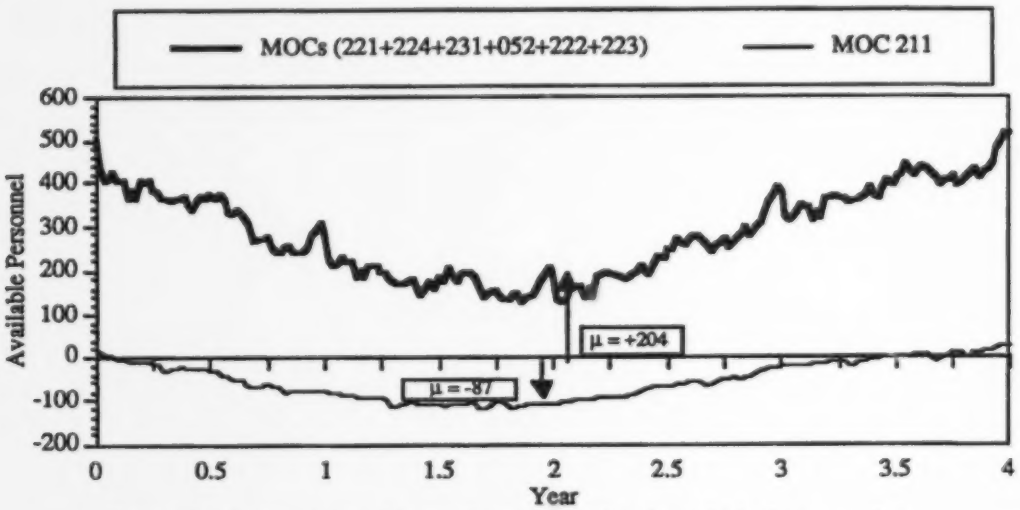

Figure 6. Comparison of lower bounds for the six technical occupations (MOCs 221 + 224 + 231 + 052 + 222 + 223) and MOC 211 (3 Oplans Activated)

5 - RECOMMENDATIONS

44. The results of this study provide sufficient justification for addressing the issue of Communications & Electronics personnel being able to maintain effective support to deployments, taskings, training and Air Command Wings. It is clear that some efficiencies could be achieved in several ways. In particular, as pointed out in the conclusions of this report, there exists an immediate concern regarding the ability of Radio Operators (MOC 211) to support deployed operations due to personnel shortages if even one Oplan is activated. It is therefore recommended that:

a. A working group of interested parties be formed with a clear mandate to explore the skill sets required to provide the necessary Telecommunications and Information Services (TIS) support to deployed air operations, and make recommendations on adjustments to procedures and training; and

b. DCOS TIS be tasked to review options to redress the situation and present findings to the executive level.

REFERENCES

[1] AIRCOM 3550-2 (DCOS TIS), 16 Feb 95.

[2] P.E. Desmier, *Optimum Manning – Airfield Engineering II. Annexes C-E*, ORD Report 93/2, June 1993.

[3] Discussion Maj. C.F. Eidt (SO Plans 5)/Dr P.E. Desmier, *OPRAM Planning Assumptions*, 23 Nov 1995.

[4] R.W. Funk, *Assessing the Risk of Air Force Personnel Shortages: Operational Personnel Risk Assessment Model (OPRAM)*, ORD Briefing Note 94/1, December 1994.

CALENDAR FOR WEEKS 1 – 52

1. The following 1995 calendar depicts the format used for matching weeks in the year to each deployment schedule. Each week starts on the Sunday. Deployments that start in the middle of the week are scheduled such that: if they start on or before Wednesday, they are allocated the week starting the previous Sunday[1]; if they start after Wednesday, they are allocated the week starting the following Sunday.

Month	Weeks	Month	Weeks
January	1, 2, 3, 4, 5	July	27, 28, 29, 30
February	6, 7, 8, 9	August	31, 32, 33, 34, 35
March	10, 11, 12, 13	September	36, 37, 38, 39
April	14, 15, 16, 17	October	40, 41, 42, 43, 44
May	18, 19, 20, 21, 22	November	45, 46, 47, 48
June	23, 24, 25, 26	December	49, 50, 51, 52

Table A-1. Weeks associated with each month of the year

January

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

February

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28				

March

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

April

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

May

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

June

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

July

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

August

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

September

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

October

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

November

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

December

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Figure A-1. 1995 Calendar

[1] The first weeks in May (18) and August (31) actually start on April 30 and July 30 respectively.

NUMBERS OF PERSONNEL PER DEPLOYMENT

1. The following tables list the numbers of personnel by rank and occupation used in each deployment scheme. Departure dates in year 1 are given in weeks. Departure dates for succeeding years can be calculated by adding multiples of 52 to the year 1 dates. For OP AIRBRIDGE, CANBAT I, OP LANCE, OP SCOTCH and OP PIVOT type 8 ACCS deployments (Table B-1), departures are randomly determined to take place within the specified period. Except for OP AIRBRIDGE and OP PIVOT, returnees are given two weeks rest before becoming fully deployable. OP AIRBRIDGE and OP PIVOT Returnees are given two months rest before becoming deployable in Canada. Out-of-country deployments occur only after remaining in Canada a full 12 months.

Deployment	Departure Date in Year 1 (Week)	Length of Deployment (Weeks)	Team Composition
OP AIRBRIDGE	1–52	26	1 x Cpl (221), 1 x Cpl (231), 1 x Sgt (231)
†CCUNPROFOR CANBAT I	1–47	3	1 x Sgt (221), 1 x Cpl (221)
EX MOUNTAINVIEW	8	1	1 x Maj (42C), 2 x Capt (42C), 1 x CWO (224), 2 x WO (231/221), 1 x Sgt (231), 3 x Sgt (221), 3 x MCpl (231), 3 x MCpl (221), 5 x Cpl (231), 5 x Cpl (221)
UNAMIR–OP LANCE	1–36	14	1 x Maj (42C), 1 x Sgt (221), 1 x Cpl (221), 1 x Cpl (231)
OP SCOTCH	1–41	9	1 x Capt (42C), 1 Sgt (221), 2 x Cpl (211), 2 x Cpl (221)

† CCUNPROFOR/CANBAT = Canadian Contingent United Nations Protective Force/Canadian Battalion

Table B-1. Rank and trade composition for 8 ACCS deployments

Deployment	Departure Date in Year 1 (Week)	Length of Deployment (Weeks)	Team Composition
BOXTOP I	16	2	1 x Lt (42C), 1 x WO (231), 6 x Cpl (211), 1 x MCpl (221), 3 x Cpl (221), 1 x MCpl (231), 3 x Cpl (231)
BOXTOP II	35	2	Same as Above
BOXTOP III	43	2	Same as Above
EX AMALGAM	18	1	1 x Capt (42C), 1 x Sgt (231), 1 x MCpl (221),
WARRIOR	36	1	1 x Cpl (221), 1 x MCpl (231), 1 x Cpl (231)
†QIAS	26	1	1 x Maj (42C), 2 x Capt (42C), 1 x CWO (231), 1 x MWO (224)
OP PIVOT	1–52	26	1 x Capt (42C), 1 x WO (224), 1 x Sgt (221), 1 x Sgt (211), 2 x MCpl (221), 1 x MCpl (231) 4 x Cpl (221)

† QIAS = Quinte International Air Show

Table B-1 (Cont'd). Rank and trade composition for 8 ACCS deployments

Deployment	Departure Date in Year 1 (Week)	Length of Deployment (Weeks)	Team Composition
COHESIVE FORCE	23	1	1 x Capt (42C), 1 x MWO (231), 1 x WO (231), 1 x MCpl (231), 1 x MCpl (221), 2 x Cpl (231), 2 x Cpl (221)
MAPLE FLAG	18–21	6	Same as above with augmentation
Fighter Weapons Instructors Course	10–15	3	Same as above with augmentation
NORTHERN PIKE	30	1	Same as above with augmentation
JOINT EX	42	2	Same as above with augmentation

Table B-2. Rank and trade composition for 42 Radar Squadron (Cold Lake)

Deployment	Departure Date in Year 1 (Week)	Length of Deployment (Weeks)	Team Composition
LONGSHOT III	14–17	1	1 x Capt (42C), 1 x WO (231), 1 x MCpl (221) 2 x Cpl (221), 1 x MCpl (231), 2 x Cpl (231)
SILENT DEFENDER	49–52	1	1 x Capt (42C), 1 x WO (231), 2 x Cpl (221), 1 x MCpl (231), 3 x Cpl (231)
FUTURO MANIA	27–30	1	1 x Capt (42C), 1 x WO (231), 2 x Cpl (221), 1 x MCpl (231), 2 x Cpl (231)
FABRIC SUNRISE	36–39	6	1 x Capt (42C), 1 x WO (231), 2 x Cpl (221), 1 x MCpl (231), 3 x Cpl (231)

Table B-3. Rank and trade composition for 12e ER (Bagotville)

FOL	Departure Date in Year 1 (Week)	Length of Deployment (Weeks)	Team Composition
COLD LAKE FOL DEPLOYMENTS			
Inuvik	6, 15, 23, 33, 45	3, 1, 2, 1, 1	1 x MCpl (231), 1 x Cpl (231), 1 x Cpl (221)
Rankin Inlet	6, 15, 23, 33, 45	3, 1, 2, 1, 1	1 x MCpl (221), 1 x Cpl (221), 1 x Cpl (231)
Yellowknife	6, 15, 23, 33, 45	3, 1, 2, 1, 1	1 x MCpl (221), 1 x Cpl (221), 1 x Cpl (231)
BAGOTVILLE FOL DEPLOYMENTS			
Iqaluit	6–8, 14–16, 23–26, 31–35, 45–48	2, 2, 1, 1, 1	1 x MCpl (221), 1 x Cpl (221)

Table B-4. Rank and trade composition for FOL deployments

Course/Qual	Dep. Date in Year 1 (Week)	Length of Course (Weeks)	MOC	Cpl	Rank MCpl	Sgt	TOTAL
MOBSATCOM/AGSR	46	4	221	4	3	1	8
QUAD/AFLZ	16	7	231	5	3		8
C&P/AGVS	1	6	231	5	3		8
	19	6	221	4	3	1	8
	35	6	231	5	2	1	8
RPDS/AHGX	10	9	231	2	5	1	8
NAMS/AGVT	8	3	221	4	4		8
CCS/AGVU	42	9	221	4	4		8
ASR/AFML	1	12	231	4	4		8
TRADS/AFNC	14	11	231	5	3		8
PAR/AFMA	14	10	231	6	2		8
ARM/AFNA	45	7	231		6	2	8
SSR/AFLY	2	9	231	5	3		8
	34	10	231	4	2	1	8
GRN 516/AHBQ	2	4	231	5	3		8
	11	5	221	6	1	1	8
	22	5	231	4	2	2	8
	47	5	231	5	1	2	8
TRN 26/AFMY	37	6	231	6	3	1	10
TRN 30/221.27	37	2	221	6	2		8
FRN 508-9-10/AFJP	40	2	221	4	3	1	8
GRD 504/AFKB	43	7	221	5	3		8
DICTA 5000/AGYM	2	3	221	6	1	1	8
	6	3	221	7	1		8
	40	3	221	4	4		8
	46	3	221	3	5		8

Table B-5. In-Service lines of training for MOC 200 NCMs

Course/Qual	Dep. Date in Year 1 (Week)	Length of Course (Weeks)	MOC	Cpl	Rank MCpl	Sgt	TOTAL
AOCCS/AGJX	22	1	231	6	2		8
	23	1	221	6	2		8
FPS117/L1/AHMN	46	4	231	3	3	2	8
FPS117/L2/AGSQ	39	6	231	2	3	3	8
TPS 70/AHHH	2	6	231	6	2	2	8
PHL7801 ILS/AGVF	41	4	231	2	4	2	8
RVR/AFJA	2	3	221	6	2		8
Airlift Security Linescan I/AFMG Linescan II/AFMH	36	2	231	6	2		8
Ceileometer/AHIH	37	1	221	4	4		8
	3	1	221	5	2	1	8
CWSR81WxRdr/AFMB	13	2	231	5	3		8
DWSR88WxRdr/AFMK	10	2	231	3	3		6
FPQ501WxRdr/NYA	38	2	231	3	3		6
READAC/.AGMR	41	2	231	2	2		4
	7	2	221	2	1	1	4
FYQ 93/AHGS	22	15	231	1	4	1	6
Tempest design/AHGZ	20	2	221			2	2
SL1 Technician/AHEN	8	3	221			3	3
	18	3	231		3		3
SL1 Overview/AGTR	7	1	221			4	4
	20	1	231		2	2	4
SL1 Programmer/ADTA	12	1	231			4	4
SX 2000/AGUR	8	2	221		2		2
FSQ 505/AFKF	38	2	221	3	4	1	8
GRD 505/AGNM	41	2	221	3	4	1	8

Table B-5 (Cont'd). In-Service lines of training for MOC 200 NCMs

Course/Qual	Dep. Date in Year 1 (Week)	Length of Course (Weeks)	MOC	Rank Cpl	MCpl	Sgt	TOTAL
E3 AWACS							
RDR MAINT/AFNG	14	24	231			3	3
C DIS TECH/AHHJ	14	24	231			3	3
RADIO MAINT/AHIA	14	24	221		3		3
Novel LSM/NYA	46	1	231		3	1	4
Novel LI/NYA	50	1	231		1	3	4
Novel NWSS/NYA	39	1	231		2	2	4
Novel LTS/NYA	43	1	231		2	2	4
IBDN Eng Basic/NYA	33	1	221		2	2	4
Internet BRG/NYA	10	1	221		2	2	4
Building Net D/AGND	4	1	221			4	4
Fibre Sys DT/AGVC	28	1	221			4	4
IBDN Eng Net/NYA	49	1	221			4	4
Implement Lans/NYA	8	1	231		4	4	8
AGA VHF/UHF/AFJI	11	2	221	8			8
AGA UHF Multi/AFJJ	13	1	221	5	3		8
MACS/AFJQ	39	12	221	1	2	2	5
FRT 510/AHEC	30	9	221	1	2	1	4
	2	9	221	2	2		4
KG 84 Ltd M/AHFQ	47	3	221		1		1
RF 230/NYA	29	3	221	3	3		6
	43	4	221	3	3		6
Fiber Optic D/AGRV	19	1	221	3			3
	20	1	221	2	1		3
	22	1	221	3			3
uWave (Basic)/AGWZ	2	4	221	2	2		4
	18	4	221	2	2		4

Table B-5 (Cont'd). In-Service lines of training for MOC 200 NCMs

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Course/Qual	Dep. Date in Year 1 (Week)	Length of Course (Weeks)	MOC	Cpl	Rank MCpl	Sgt	TOTAL
uWave (uTel)/aGWV	31	4	221	2	3		5
	36	4	221	2	3		5
PC Repair/AEZB	2	3	221	2	2		4
	30	3	231	2	2		4
HRS/AHFQ	16	2	221	3	3		6
	31	2	231	4	2		6
RAD DET M&C/AGMZ	10	6	221	2	2		4
	17	6	221	2	2		4
	23	6	221	1	3		4
COMM/RDR 6B/224-2316B	2	12	221			12	12
	37	12	231			6	6

Table B-5 (Cont'd). In-Service lines of training for MOC 200 NCMs

Course/Qual	Dep. Date in Year 1 (Week)	Length of Course (Weeks)	MOC	Lt	Rank Capt	Maj	TOTAL
TEMPEST rules/AGVV	34	2	42C	2			2
SL1 Overview/AGTR	25	1	42C	4			4
CELE Air B1/42B601	22	11	42C	9			9
CELE Air B2/ADRZ	2	9	42C	7			7
CELE ACCIS/ADRS	42	8	42C		7		7

Table B-6. In-Service lines of training for CELE officers

Exercise	Departure Date in Year 1 (Week)	Length of Exercise (Weeks)	Team Composition
Joint Maple Flag (Cold Lake)	21	3	2 x Cpl (221), 2 x Capt (42C)
Maple Flag (Cold Lake)	16	3	2 x Cpl (221)
	17	3	1 x Cpl (221)
	21	3	1 x Cpl (221)
	23	3	2 x Cpl (221)
Boxtop	16	2	4 x Cpl (211), 1 x Sgt (211), 4 x Cpl (231)
	36	2	4 x Cpl (211), 1 x MCpl (211)
	43	2	3 x Cpl (211), 1 x MCpl (211)
El Gorah, Egypt	1	52	1 x WO (224)

Table B-7. Rank and trade composition for Exercises

OPLAN	Surge Composition	Oplan Steady State Composition
SPECTRE (MOB, DOB and BB)	10 x Cpl (052), 2 x MCpl (052), 1 x Sgt (052), 1 MWO (052)	12 x Cpl (221), 6 x MCpl (221), 2 x Sgt (221), 1 x CWO (224), 8 x Cpl (231), 4 x MCpl (231), 3 x Sgt (231),2 x WO (231), 8 x Cpl (052), 2 x MCpl (052), 2 x Sgt (052), 1 x WO (052), 22 x Cpl (211), 6 x MCpl (211), 1 x Sgt (211), 1 x WO (211), 1 x MCpl (212), 1 x Sgt (212), 1 x Cpl (222), 1 x MCpl (222), 2 x Capt (42C), 1 x Maj (42C)
ORCA (DOB)	4 x Cpl (052), 2 x Sgt (052)	11 x Cpl (221), 5 x MCpl (221), 1 x Sgt (221), 1 x Cpl (223), 1 x MCpl (223), 1 x WO (224), 1 x CWO (224), 5 x Cpl (231), 3 x MCpl (231), 1 x WO (231), 4 x Cpl (052), 2 x MCpl (052), 33 x Cpl (211), 9 x MCpl (211), 2 x Sgt (211), 1 x WO (211), 1 x MCpl (212), 1 x Sgt (212), 2 x Capt (42C), 1 x Maj (42C)

Table B-8. Rank and communication occupation composition for Oplan deployments

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OPLAN	Surge Composition	Oplan Steady State Composition
ORCA (MOB)		3 x Cpl (221), 2 x MCpl (221), 1 x Sgt (221), 1 x WO (231), 2 x Cpl (211), 3 x MCpl (211), 1 x Sgt (211), 1 x Capt (42C)
IGLOO		8 x Cpl (221), 8 x MCpl (221), 5 x Cpl (231), 5 x MCpl (231)
FORTUNE		3 x Cpl (221), 2 x MCpl (221), 1 x Cpl (231), 1 MCpl (231), 3 x Cpl (211), 1 x MCpl (222)
SABRE (24/36)		14/19 x Cpl (231), 6/10 x MCpl (231), 2/5 x Sgt (231), 1/1 x WO (231), 1/1 x MWO (231)
CONVEYOR (DOB and BB)	4 x Cpl (052), 2 x Sgt (052)	9 x Cpl (221), 7 x MCpl (221), 4 x Sgt (221), 1 x Cpl (223), 1 x MCpl (223), 2 x WO (224), 4 x Cpl (231), 4 x MCpl (231), 1 x Sgt (231), 1 x WO (231), 2 x Cpl (052), 2 x MCpl (052), 23 x Cpl (211), 10 x MCpl (211), 3 x Sgt (211), 1 x MCpl (212), 1 x Sgt (212), 2 x Capt (42C)
CONVEYOR (MOB)		3 x Cpl (221), 2 x MCpl (221), 1 x Sgt (221), 1 x WO (231), 2 x Cpl (211), 3 x MCpl (211), 1 x Sgt (211), 1 Capt (42C)

Table B-8 (Cont'd). Rank and communication occupation composition for Oplan deployments

Annex C
to Op Rsch Report 95/2
December 1995

FULLY DEPLOYABLE PERSONNEL BY MOC AND RANK

1. Figures C-1 – C-9 illustrate the steady state number of C&E personnel by MOC and rank that are fully deployable (based on the activation of one Oplan). Each graph represents the number of personnel available for work on Air Command Wings or deployments outside Canada in a four year period. A steady state flow in the number of personnel was achieved in the period 1 – 3 years inclusive.

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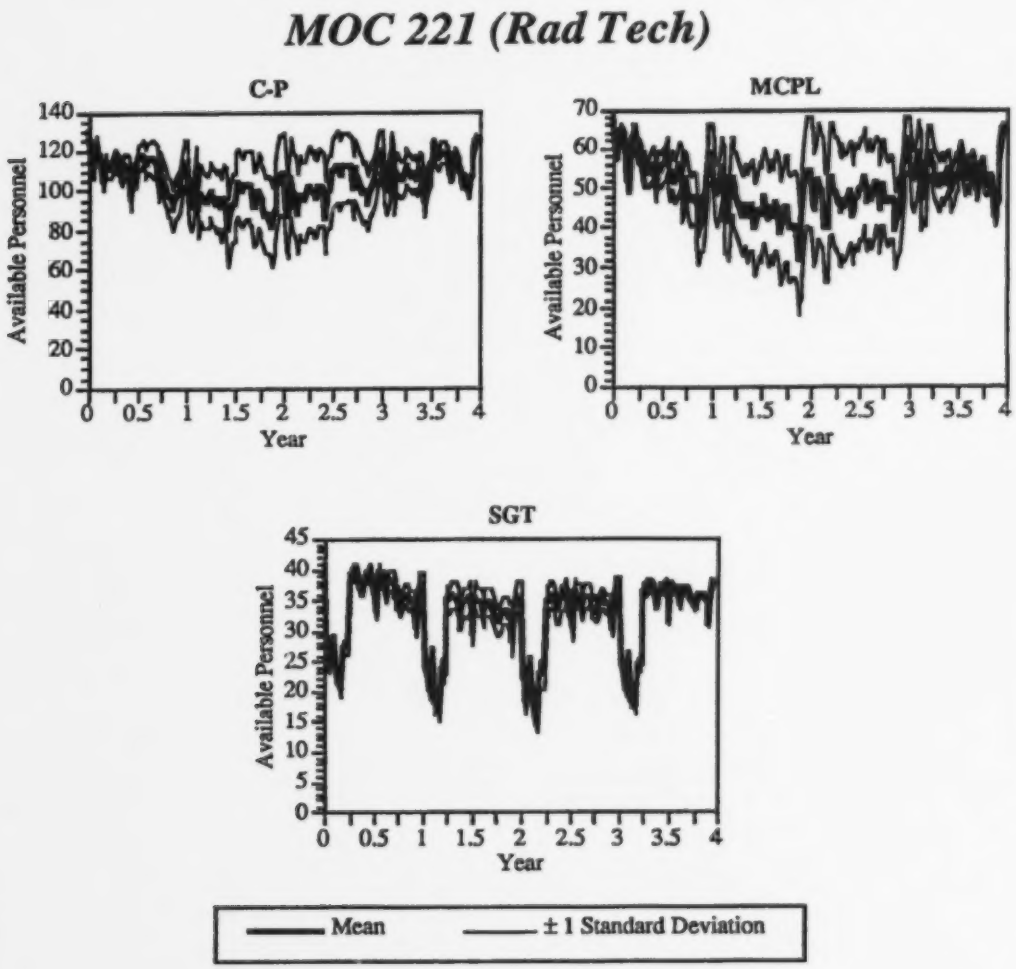

Figure C-1. Fully deployable MOC 221 personnel (1 Oplan Activated)

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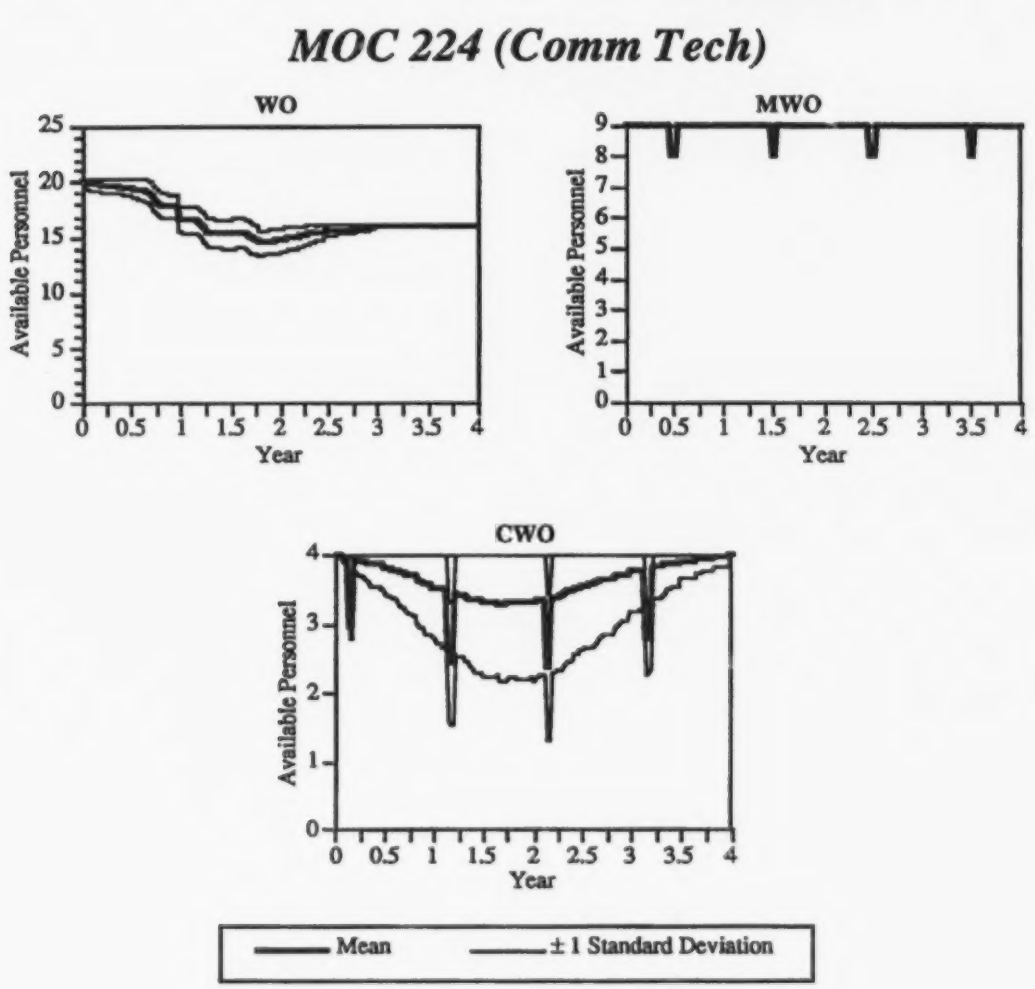

Figure C-2. Fully deployable MOC 224 personnel (1 Oplan Activated)

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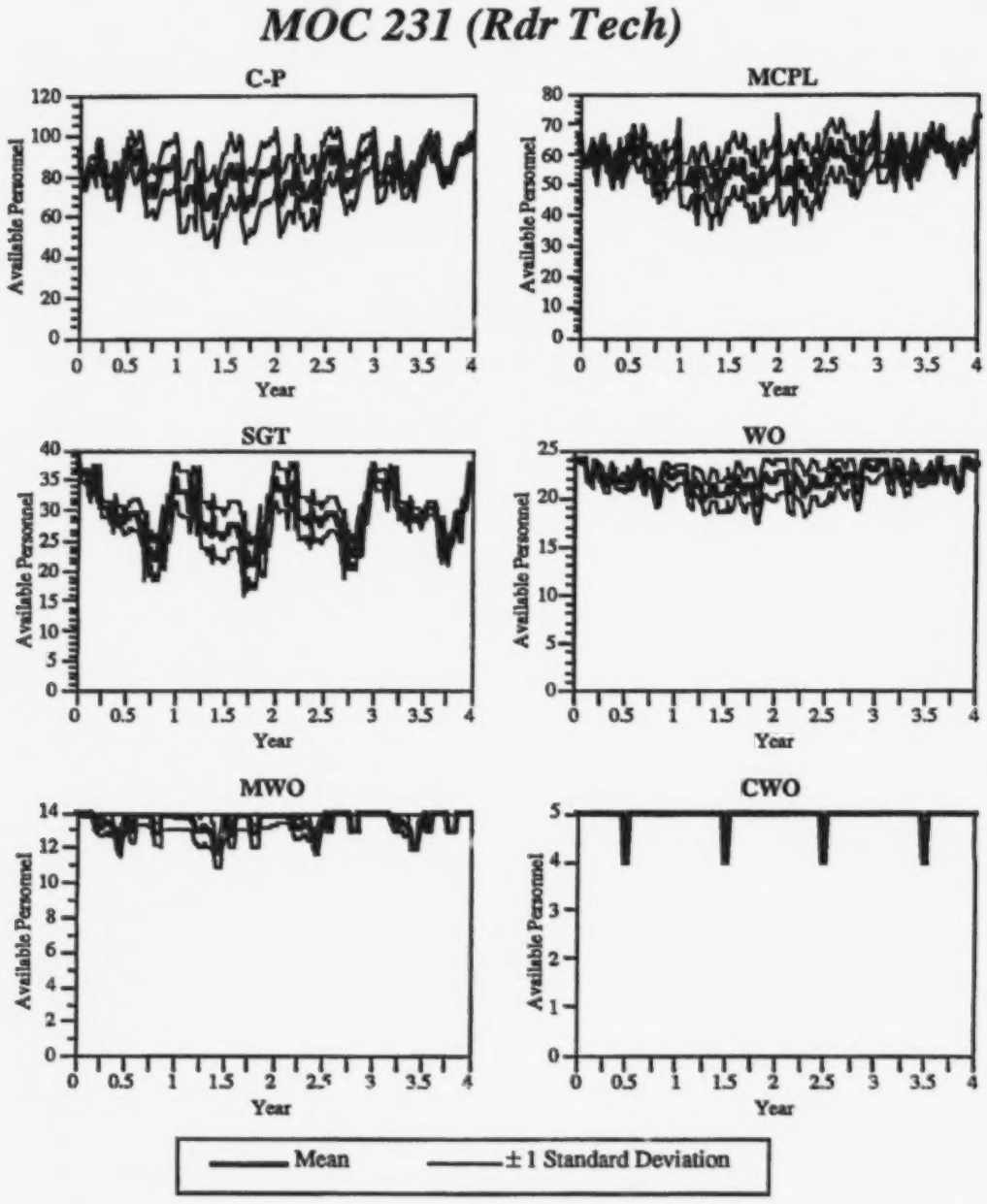

Figure C-3. Fully deployable MOC 231 personnel (1 Oplan Activated)

MOC 052 (Linemen)

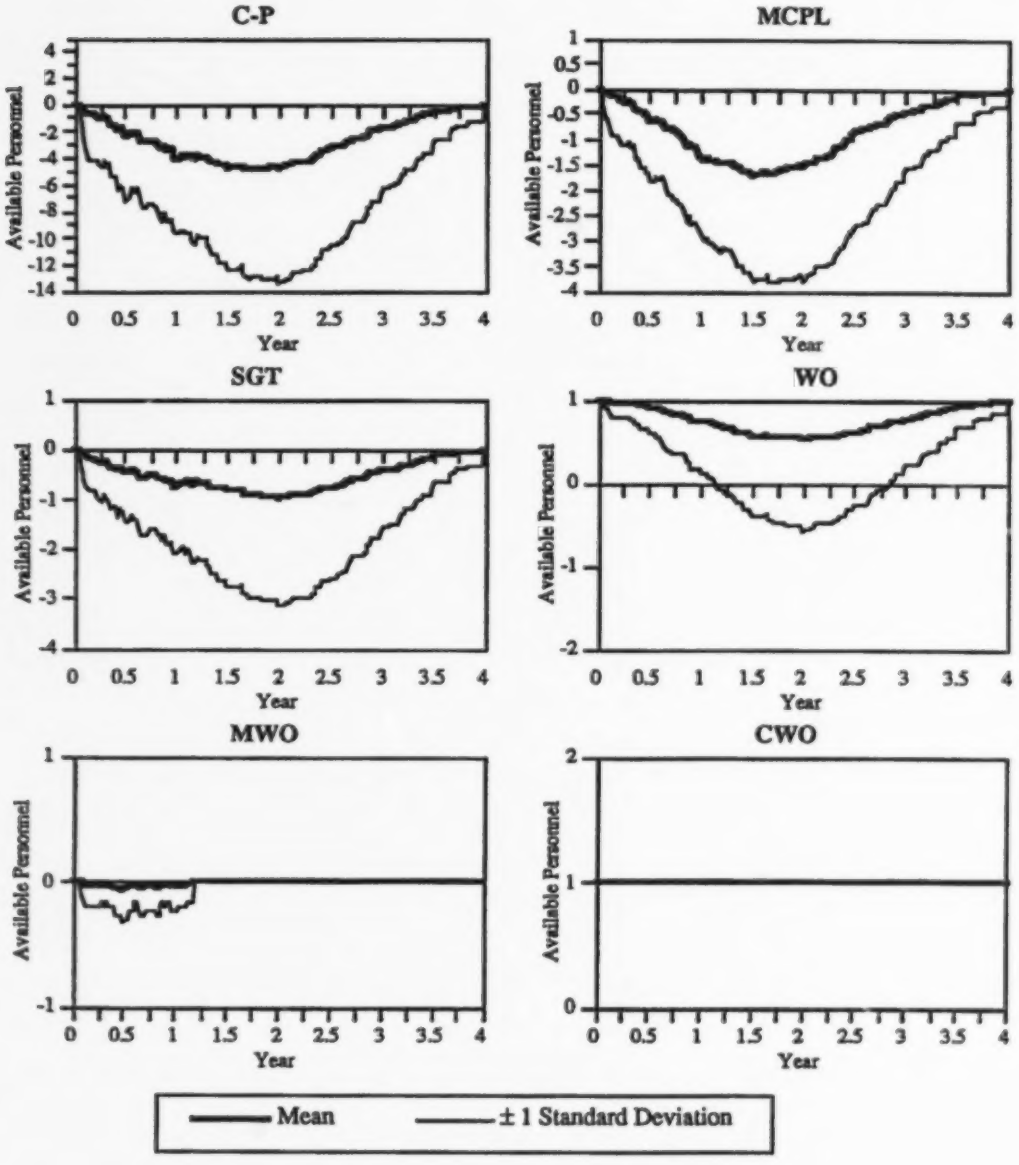

Figure C-4. Fully deployable MOC 052 personnel (1 Oplan Activated)

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MOC 211 (Rad Op)

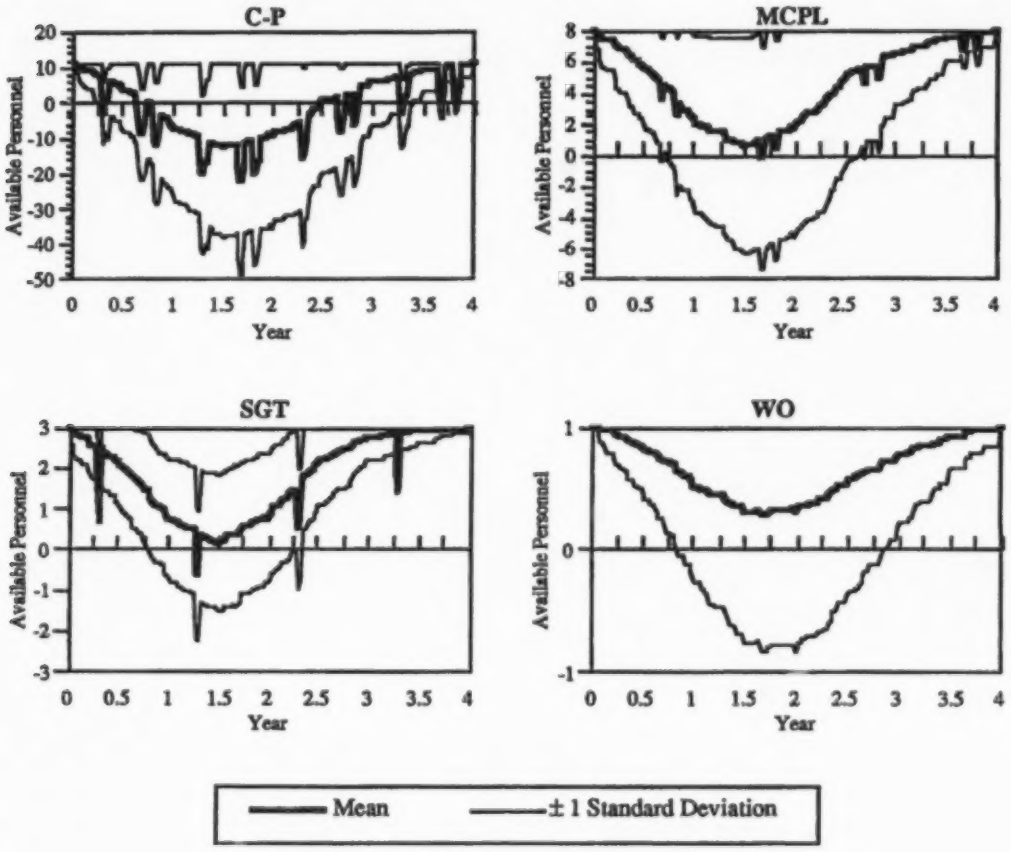

Figure C-5. Fully deployable MOC 211 personnel (1 Oplan Activated)

MOC 212 (Tel Op)

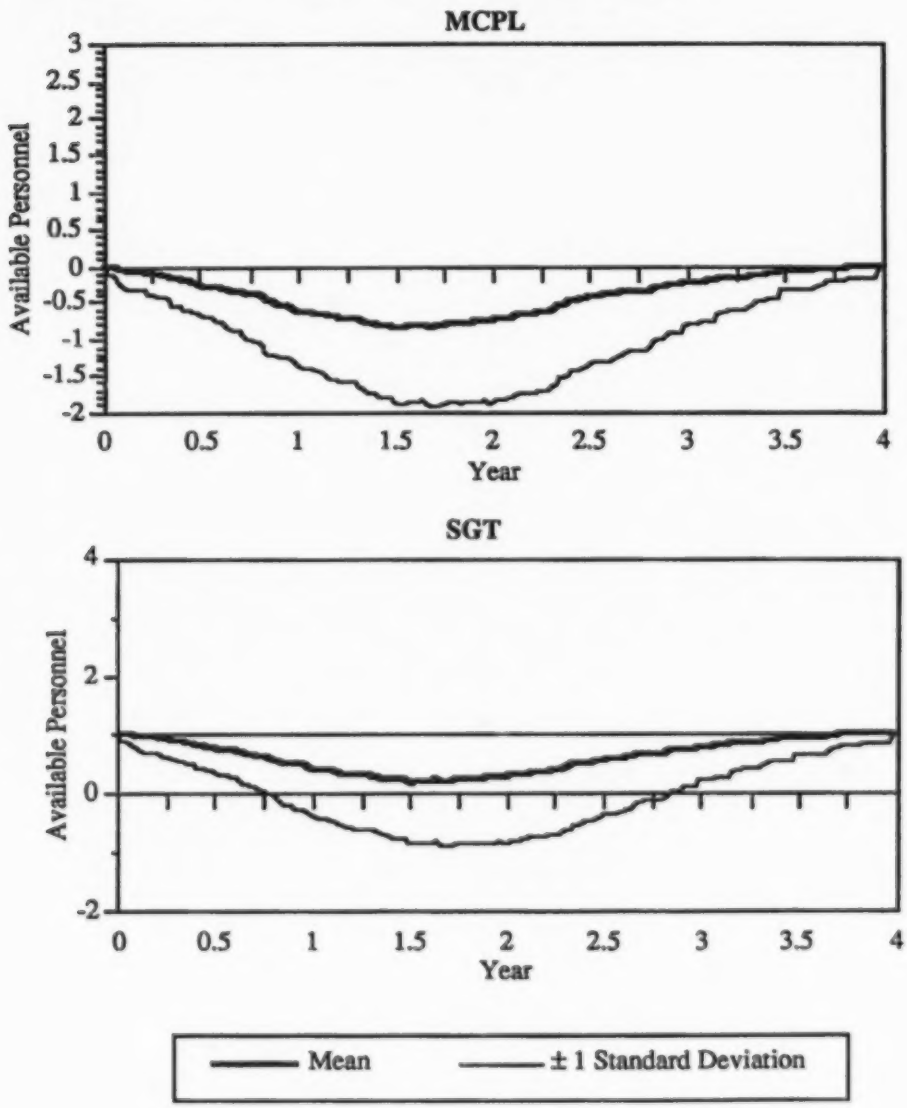

Figure C-6. Fully deployable MOC 212 personnel (1 Oplan Activated)

MOC 222 (TE Tech)

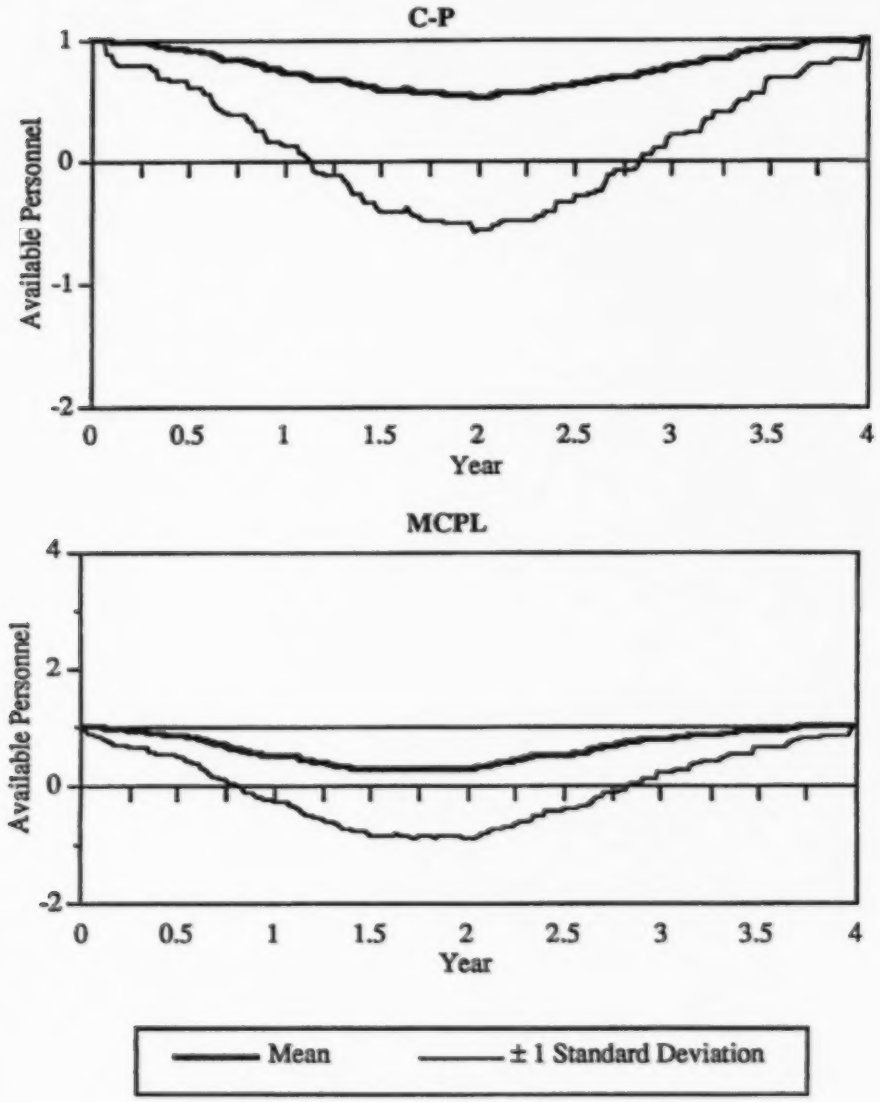

Figure C-7. Fully deployable MOC 222 personnel (1 Oplan Activated)

MOC 223 (Tel Tech)

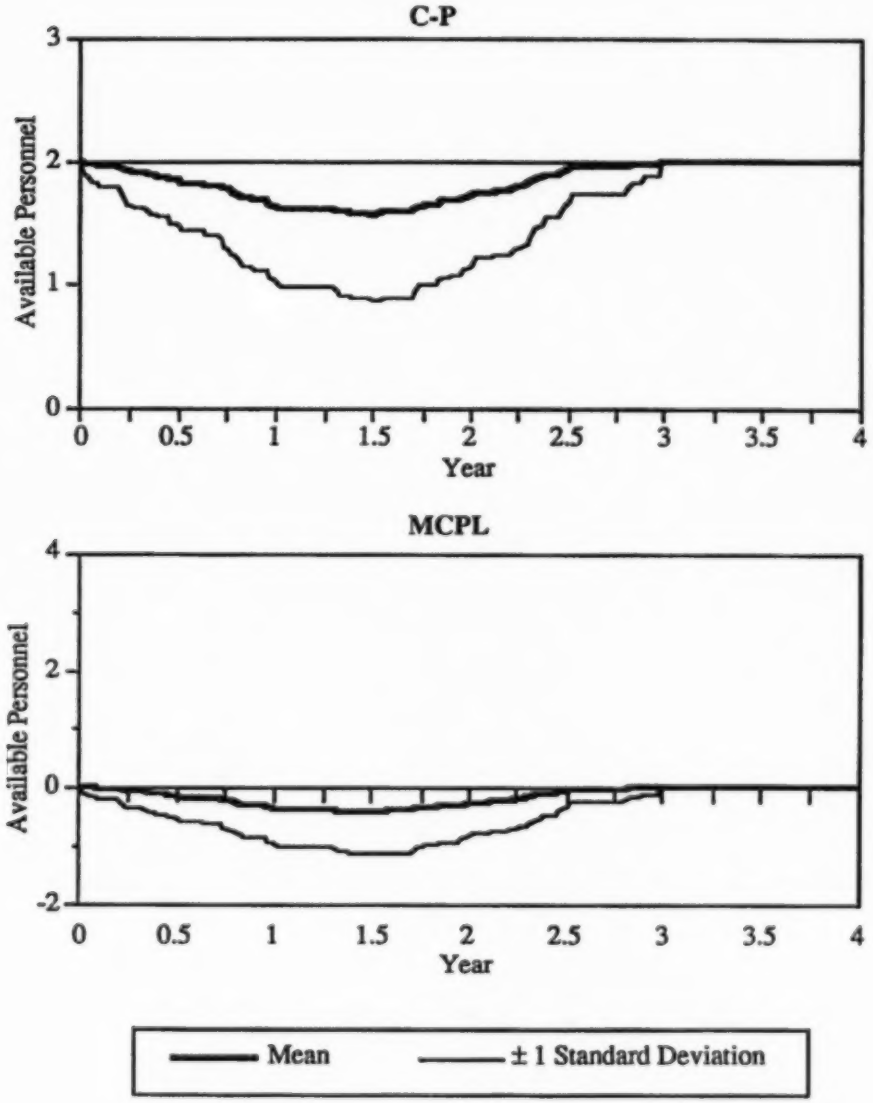

Figure C-8. Fully deployable MOC 223 personnel (1 Oplan Activated)

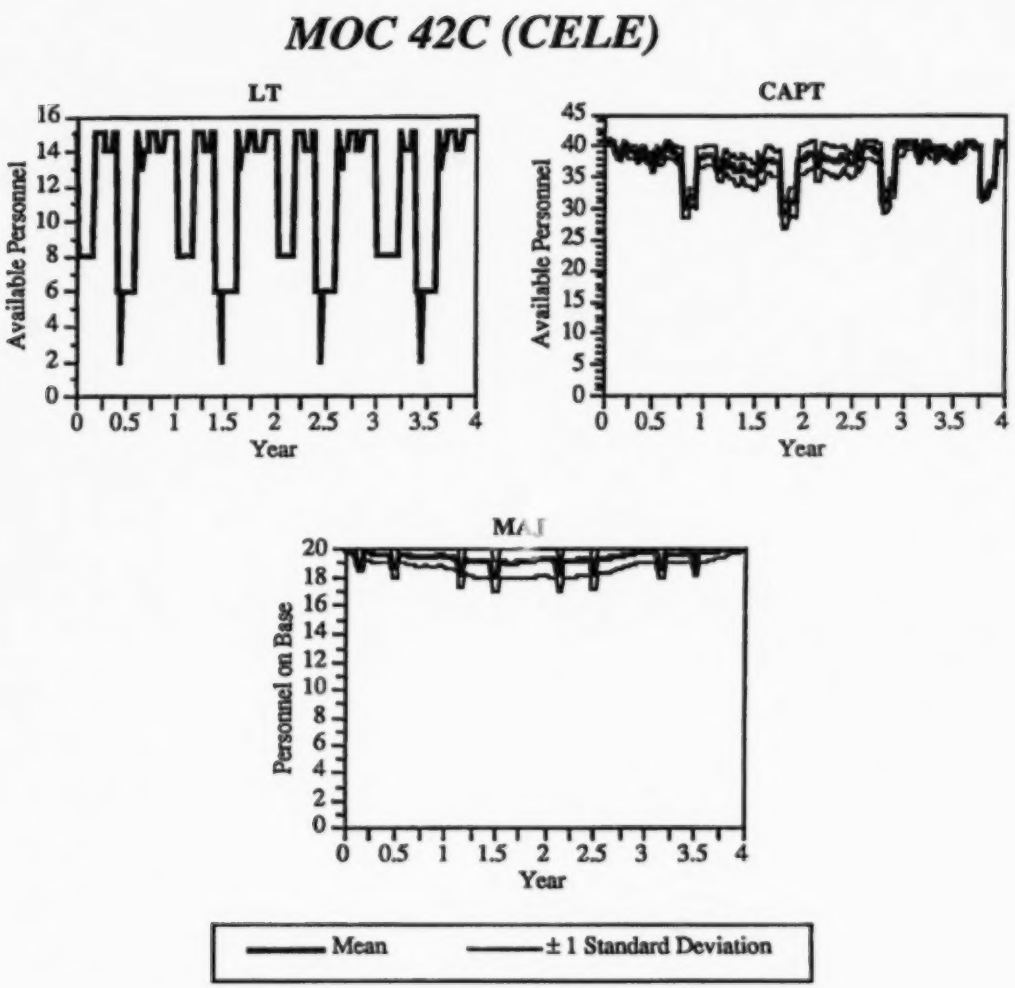

Figure C-9. Fully deployable MOC 42C personnel (1 Oplan Activated)

FULLY DEPLOYABLE PERSONNEL BY MOC

1. Figures D-1 – D-3 illustrate the steady state number of C&E personnel by MOC that are fully deployable (based on the activation of one Oplan). Each graph represents the number of personnel available for work on Air Command Wings or deployments outside Canada in a four year period. A steady state flow in the number of personnel was achieved in the period 1 – 3 years inclusive.

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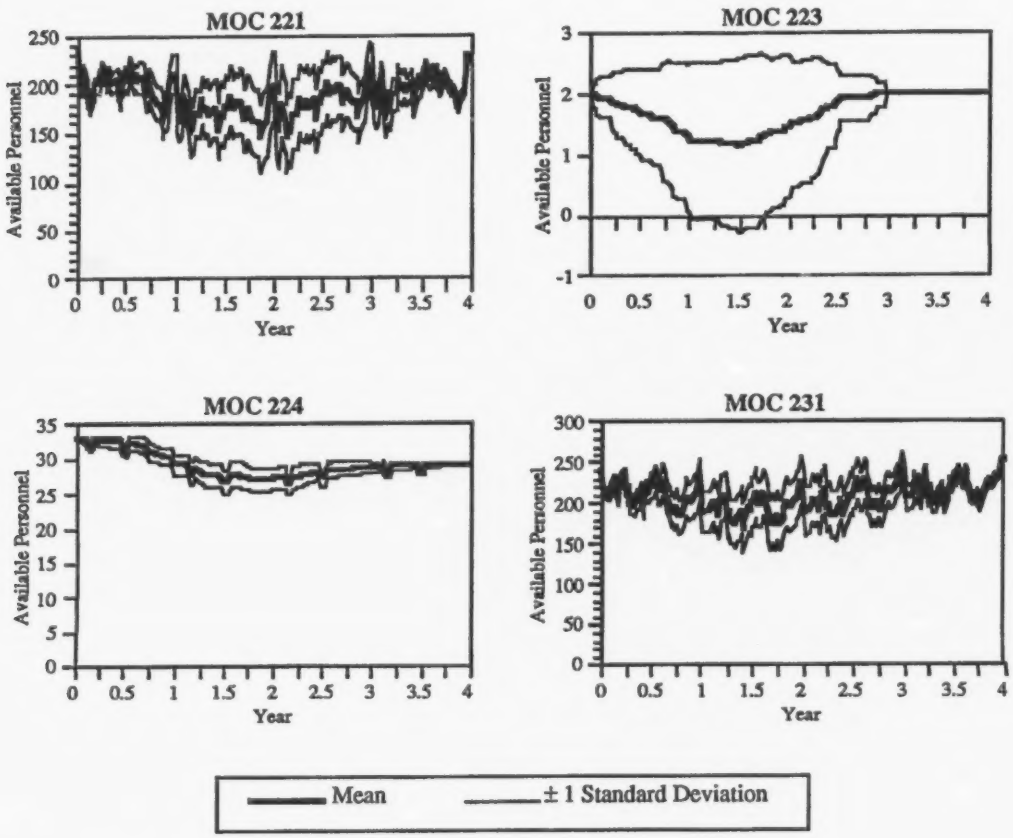

Figure D-1. Fully deployable personnel (by MOC; 1 Oplan Activated)

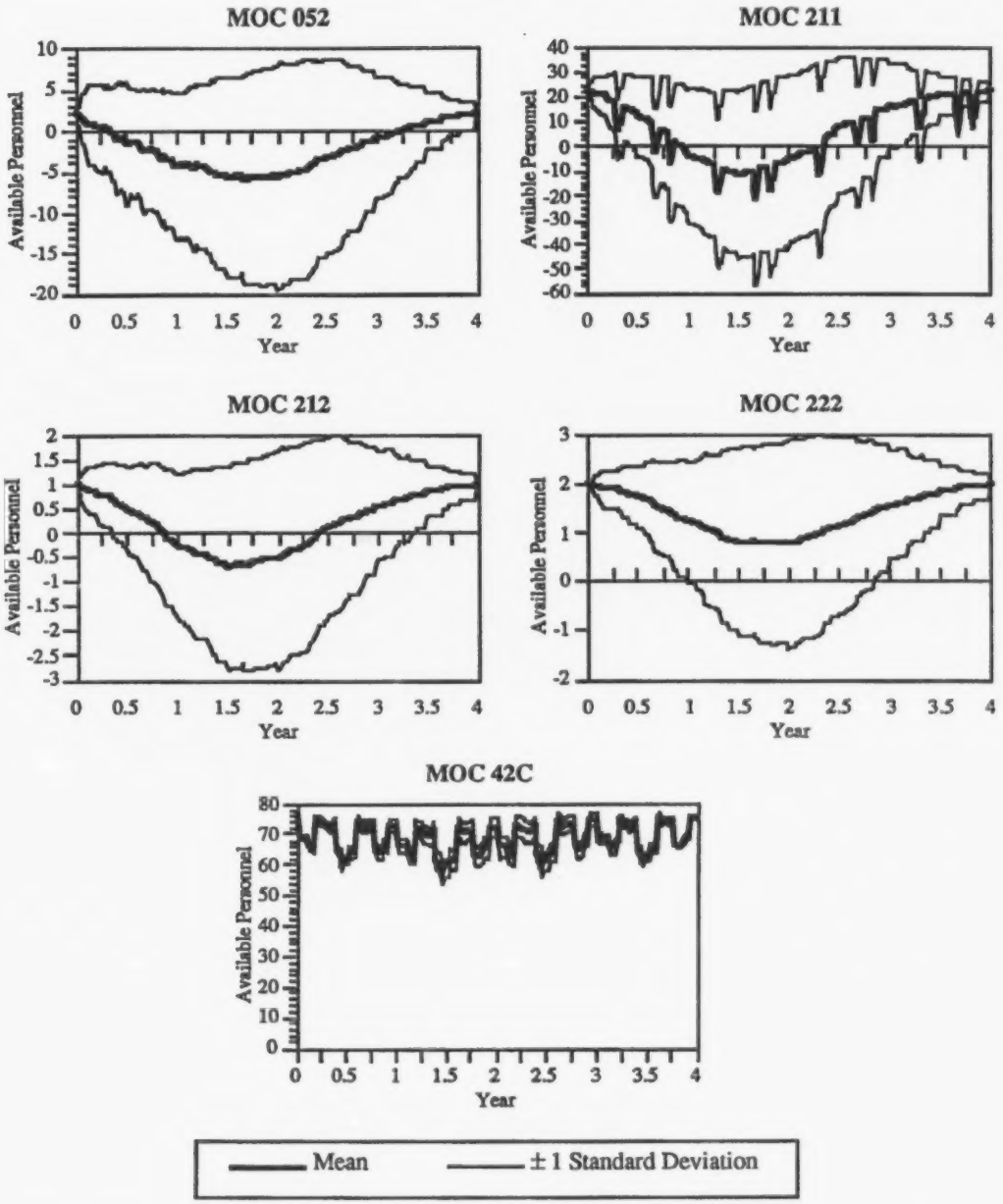

Figure D-2. Fully deployable personnel (by MOC; 1 Oplan Activated)

Annex E
to Op Rsch Report 95/2
December 1995

FULLY DEPLOYABLE PERSONNEL

1. Figures E-1 – E-2 illustrate the steady state number of C&E personnel that are fully deployable (based on the activation of one Oplan). Each graph represents the number of personnel available for work on Air Command Wings or deployments outside Canada in a four year period. A steady state flow in the number of personnel was achieved in the period 1 – 3 years inclusive.

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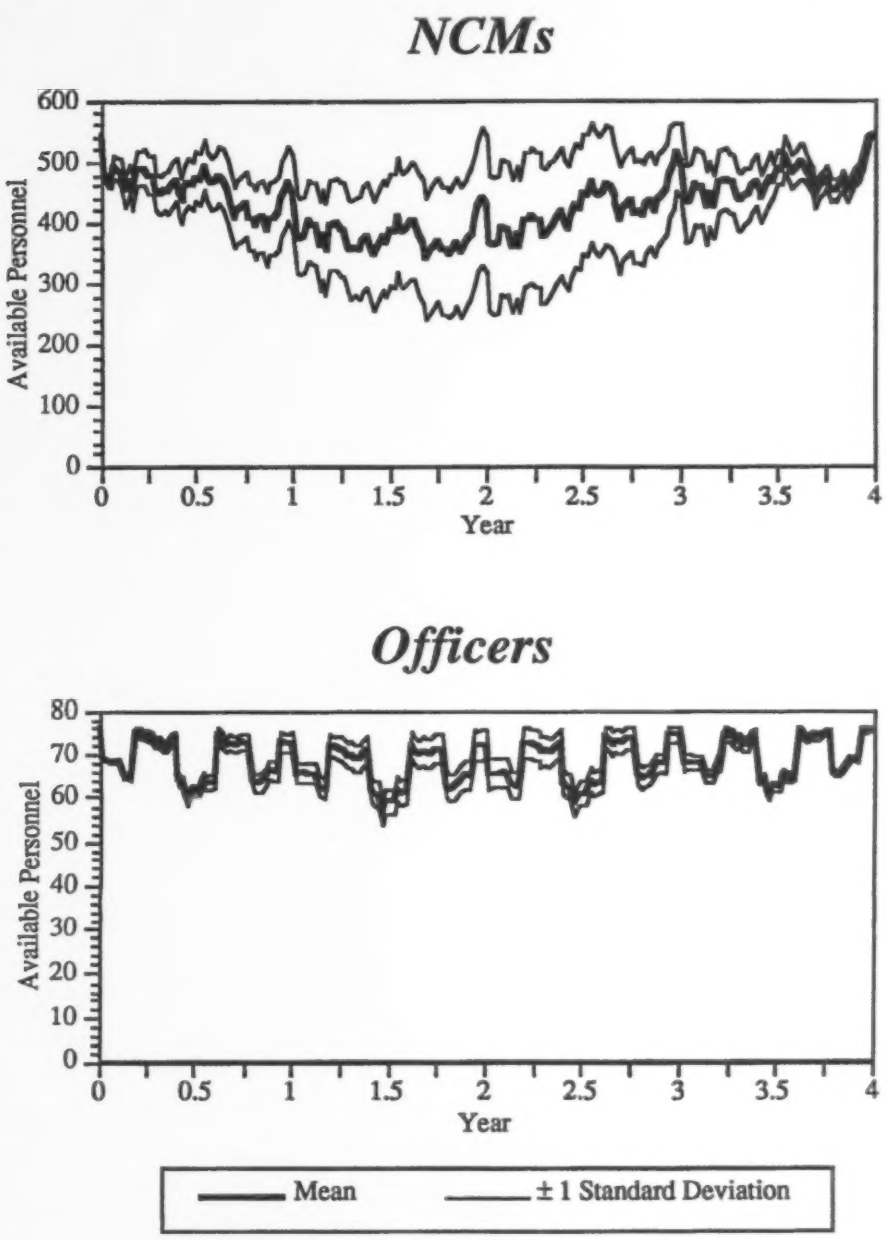

Figure E-1. Fully deployable personnel (NCMs and Officers; 1 Oplan Activated)

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1. The principal aim of this study was to determine the optimum number of regular force Communications & Electronics (C&E) personnel required to effectively support all deployments and taskings including Operational Plans (Oplans), annual training and exercises. The methodology used to determine the optimum number of C&E personnel is based on stochastic modelling of real life taskings. The establishment strength effective 11 Apr 95 was used as the baseline number of C&E personnel.

2. The results of this study provide sufficient justification for addressing the effective use of C&E personnel. It is clear that some efficiencies could be achieved in several ways. In particular, as pointed out in the conclusions of this report, there exists an immediate concern regarding the ability of Radio Operators (MOC 211) to support deployed operations due to personnel shortages if even one Oplan is activated.

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